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# PYROTECHNIA
## OR,
## A DISCOVRSE OF
## ARTIFICIALL
## *FIRE-WORKS:*

In which the true Grounds of that Art are plainly *and perſpicuouſly laid downe:*

Together with ſundry ſuch Motions, both *Straight* and *Circular, performed by the helpe of Fire, as are not* to be found in any other Diſcourſe of this kind, *Extant in any Language.*

VVhereunto is annexed a ſhort TREATISE of *Geometrie, contayning certaine* Definitions *and* Problemes, for the Menſuration of *Superficies* and *Solids*, with *Tables* for the Square Root to 25000, and the Cubick Root to 10000 *Latus*, *wherein all Roots under thoſe Numbers are extracted onely by Ocular Inſpection.*

VVritten by *John Babington* Gunner, and Student *in the* MATHEMATICKS.

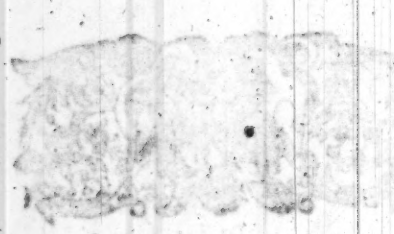
*LONDON*,
Printed by THOMAS HARPER, for RALPH MAB,
MDCXXXV.

# PYROTECHNIA

OR,

# A DISCOVRSE OF ARTIFICIALL AIRE-WORKS:

BRITISH MUSEUM



Printed by THOMAS HARPER, for RALPH MAB.
MDCXXXV.

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# TO
# THE RIGHT HONOV-
# RABLE, THE EARLE OF
## *Newport*, Master of his Majesties Ordnance, my singular good Lord.

*Right Honourable:*

I Am not induced to present this Treatise to your Lordship for any worth that is either in it, or in my selfe, the Author of it; the thing being of small moment, and my selfe of as little account: but your Lordships singular clemency to all, and your Honourable favour vouchsafed to me in particular, hath made me thus bold, and hath caused me thus farre to presume. I have beene for certaine yeeres past, and so at present am, one of the inferiour Gunners of his Majestie; and ever since I held that place, I have endeavoured to gaine such skill and experience, as I esteemed most requisite for that service. And to that end I have bestowed some time and expence, as my occasions and ability would permit, in the practise of *Artillery* and *Fire-workes*, wherein though I have chiefly aymed at such conclusions as might be usefull against an enemy in the *field*, yet these *halcyon* dayes of peace and tranquility, which

through the goodneſſe of God we have ſo long enjoyed, have given mee occaſion to invent and practiſe ſuch alſo as theſe following: which howſoever they may ſeeme to ſerve onely for delight and exerciſe, yet as by the handling of theſe there may bee gained knowledge in the natures and operations of the ſeverall ingredients and their compoſitions; ſo the due conſideration of the ordering of them may excite and ſtirre up in an ingenious minde, ſundry inventions more ſerviceable in times of warre. Now becauſe your Lordſhip hath of late, by the gratious providence of the Almighty, for your extraordinary wiſedome and worth, beene advanced to that eminent place, upon which I have ſome dependance, and to which I ſtand obliged by my ſpeciall ſervice (to which alſo all workes of *Pyrotechnie* may ſeeme to have relation) I hold it my bounden duty to preſent theſe firſt fruits of my labours to your Honour, as an unfayned teſtimony, and an undoubted evidence of my faithfull obſervance, and ſingular reſpect to your Lordſhip: which if you ſhall be pleaſed to take into your ſpecial Patronage and protection, I ſhall be in good hope to be freed both from the venomous tooth of *Momus*, and from the malevolent aſpect of *Zoilus*, and from the poyſoned breath and ſtinging of the reſt of that viperous brood, and ſhall alwaies remaine

*Your Honour's in all dutifull obſervance,*

IOHN BABINGTON.

# TO THE READER.

Courteous Reader,

*HAving for mine owne private recreation, ſpent ſome vacant houres in the ſtudy and contemplation of thoſe artificiall* Fire-works *which are diſcourſed of in the enſuing Treatiſe; I held it requiſite for my further and better ſatisfaction, as any opportunity did offer it ſelfe, to make experiment of ſome of the particularities there ſet downe; and I did accordingly now and then bring into* Act *that whereof before I had but a meere* Notion, *and the bare and naked* Theorie: *which becauſe it could not be done ſo privately, but that of neceſsity ſometimes it would come to the view of others; by that meanes it is come to paſſe, that more notice than I was ever willing to, hath beene taken, that I have beſtowed ſome thoughts upon that ſubiect, and taken more than ordinary paines in it. And not ſo onely, but thereupon alſo ſome of my intimate friends and acquaintance, who have a ſpeciall intreſt in me, have beene very inſtant and urgent with me that I would make my labours more publike, and communicate them to the world, by committing them to the Preſſe: whereto though I was*

*a long while utterly unwilling, as being conſcious to my ſelfe of mine owne inability and inſufficiency to deviſe and contrive any thing worthy to come to ſuch publike view, yet their importunity hath at laſt ſo farre prevailed with me, that thoſe rude and unpoliſhed lines are now like to ſee the Sunne; and to come abroad to be ſcanned and cenſured by others. If thou ſhalt looke upon them with a faire and favourable eye, I ſhall bee encouraged to beſtow my paines upon ſome other thing, which may happily give thee more content, and in the meane while ſhall reſt*

**Thy true friend and well-willer,**

**IOHN BABINGTON, Gunner.**

## In laudem Authoris IOANNIS BABINGTON *Amici & in Arte Matheſios celeberrima Socii.*

THe pleaſant object of cloſe ardent Bowres,
Envelloped with *Florae's* fragrant flowres,
The goodly Proſpect of Skie-kiſsing Hils,
Or fertile Plaines vein'd ore with purling Rils;
More raviſh not my ſences with delight,
Then doth thy *Pyrotechnie*. Many write
Of Arts in themſelves worthy, but their worth
Is much impaird by thoſe that ſet them forth,
Wholly unskill'd in *Megatheologie*,
The very ſoule of each deepe Myſterie.
I wiſh ſuch ſhallow men would meddle leſſe,
And with their ſenſeleſſe ſtuffe not cloy the Preſſe.
All ſuch his Schoole to paſſe by *Plato* wilde
In beautifull Geometrie not skild.
Well haſt thou then my Friend expreſt thy Art,
Since this rare Science hath the greater part
Shar'd in thy Worke, giving it winged fire,
To mount it up-aloft, and deck the ayre
With ſplendent ſtars, ſilver and golden ſhowers;
Theſe are th'effects of *Mathematick* powers:
Which crown their *Authors* temples, not with bayes,
But with a wreath of ſtars and fulgent rayes.
Fairly goe on, thy ſelfe ſuch *Trophies* reare,
That neither *Time* nor *Envie* may outweare;

*Tho. Stutevill. Philomathes.*

Vnto his worthy Friend, and induſtrious Artiſt,
Maſter IOHN BABINGTON.

*VVHen as I did thy Booke by chance eſpie,*
*With diuers figures grac't, moſt curiouſly*
*Contriu'd, all new, and of thine own inuention,*
*With ſundry Engines made by iuſt proportion:*
*I did admire thy skill, thy actiue braine,*
*Whereby thoſe things thou didſt ſo well attaine:*
*Juſtly I might, for of no Nation yet,*
*There's any hath this path ſo fully beat;*
*Nor laid thoſe grounds that thou haſt done, whereby*
*We might attaine to things that tend ſo high.*
*For ſenceleſſe things with life thou ſeem'ſt to fill,*
*Making them wondred at by common skill.*
*Thou ſundry doubts unfold'ſt, and with much eaſe,*
*Thou teacheſt us to meaſure Land and Seas.*
*When as I thought on theſe, and knew how rare*
*Men thus addicted, and thus giuen were,*
*My mind, my hand, my hand did force my pen,*
*T' offer my mite of thankes 'mongſt other men.*
*Accept it then, and let it no leſſe bee*
*Pleaſing, then greater gifts are unto thee.*

Thy truly affectionate, and wel-
wiſhing Friend,

*John Bate.*

## In commendations of his worthy Friend Maſter *Iohn Babington* Gentleman.

I f I were worthy to extoll the Name
O f him that ſpends the 'Elixer of his ſpirits,
H ow rare deſinde, I ſhould ſet forth the ſame,
N ere ſhould I flinch; for why thy great demerits
B ravely ſhould arme me boldly to oppoſe
A gainſt thy Criticks and back-biting foes,
B rave man of worth proceed: the rareſt wits,
I f thy rare Worke doe come but in their view,
N ere doubt, but they as ſoone as God permits,
G reat love and aid will then expreſſe to you,
T hat ſpends your time, ſpirits, and great expence
O n Countries good for love, not recompence.
N ow tell me thou that haſt a Talent lent,
Which was receiv'd from *God Omnipotent*,
And hor'dſt it up, burying it with thy Name,
It there takes Period, ending with thy frame.
When this my Authors fame, I iuſt preſage,
Shall flouriſh ſtill, and not weare out with age.

Thy Friend IOHN HICKS, *alias*

*Bridgbampton* Gunner.

In commendations of his worthy Friend M. Walter

# A Treatiſe of ARTIFICIALL FIRE-WORKS, moſt of them being invented and approved by the Author.

## CHAPTER I.

### *How to make all ſorts of moulds, in a true proportion, with the Rowlers and Drifts.*

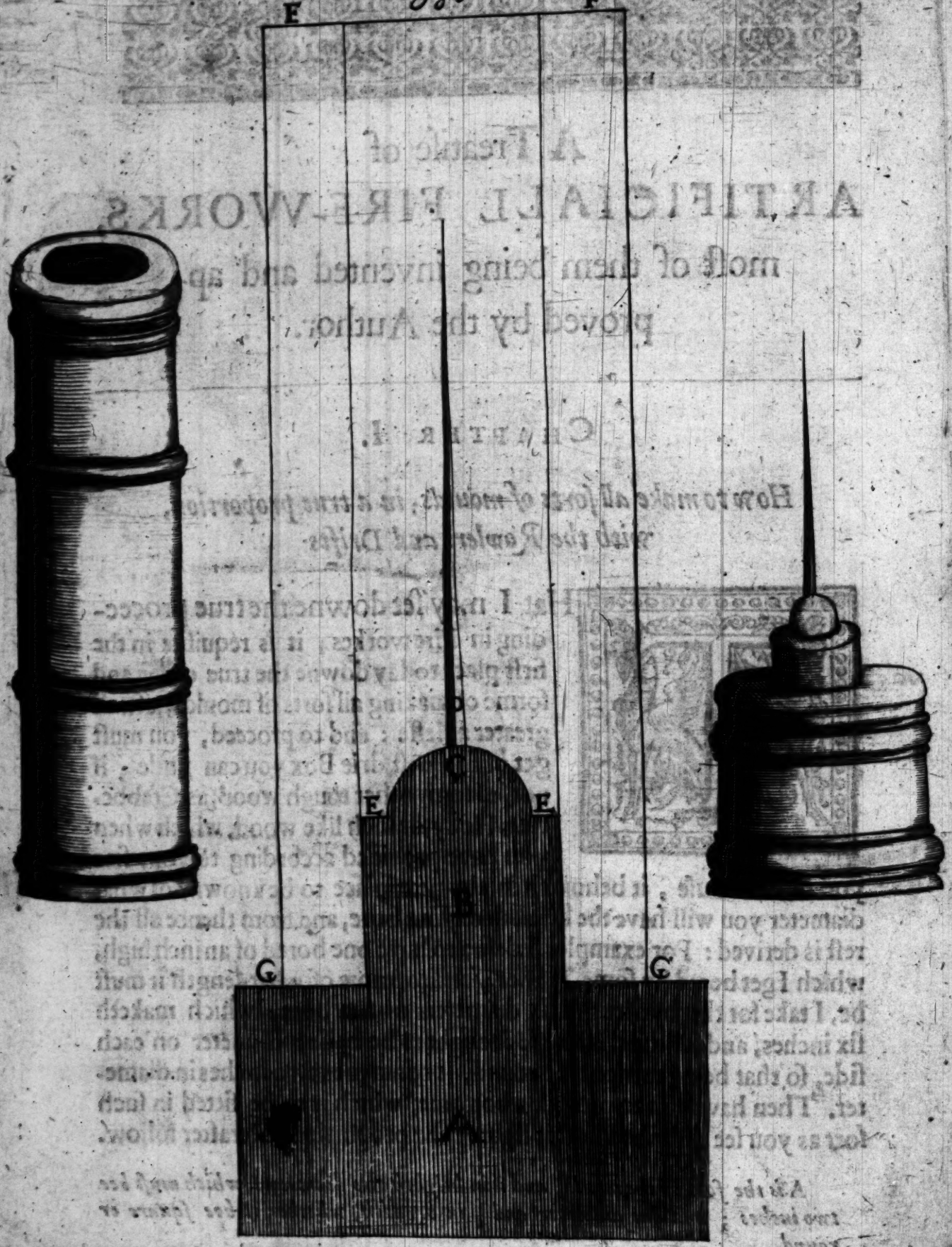
WHat I may ſet downe the true proceeding in Fireworkes, it is requiſite in the firſt place to lay downe the true order and forme of making all ſorts of moulds, aſwell greater as leſſe: and to proceed, you muſt get of the beſt drie Box you can finde; if not, of ſome other tough wood, as Crabbe-tree, Holly, or ſuch like wood, which when you have provided according to your ſize you meane to uſe, it behoveth in the next place to be known, of what diameter you will have the heighth of your bore, and from thence all the reſt is derived: For example, I deſire to have one bored of an inch high, which I get bored by ſome Turner; and to know of what length it muſt be, I take for the ſayd length ſix diameters of the bore, which maketh ſix inches, and for the thickneſſe it ought to be halfe a diameter on each ſide, ſo that being turned true round, it contaynes two inches in diameter. Then have you to provide a bottome, which is to be fitted in ſuch ſort as you ſee deſcribed in this figure: the proportions heerafter follow.

*A is the foot of the mould, and is in heighth two diameters, which muſt bee two inches; and one diameter and ½ in breadth, whether it bee ſquare or round.*

*B ſerveth only for a ſtay, and muſt ariſe one inch into the mould, which is one diameter, and ſo proportionall in all other ſorts.*

*C is for the mouth of the rocket, and is in diameter ⅓ of the bore; ſo ſetting one foot of the compaſſes in the center, deſcribe the arch, which is the full heighth required.*

Fig. 1



*E E serveth for the paper being rowled, and is $\frac{1}{6}$ part of the diameter on each side:*

*F F is the thicknesse of the mould, which is halfe the diameter of the bore, that is in this place halfe an inch.*

*F G the length of the mould, which is six diameters.*

*D the length and bignesse of the needle, which is $\frac{2}{3}$ the length of the mould, and bignesse to be $\frac{1}{3}$ of the diameter of the bore at the bottom, and fare taper to the top.*

When you have provided your mould according to your desire, then you are to fit your rowler, which must be two third parts of the diameter of the bore of the layd mould, and the length thereof to bee six inches longer than your mould, which is for the roling of your paper, and is described by the letter A in this second figure, with a hole to be bored in the bottom to receive a wyer, which must bee fastned in another peece of wood somewhat shorter, which is to take out at pleasure, as you may see described by the letter D: there is required no proportion of length for this short peece, only it sufficeth if it be but so long as a man may well hold it in his hand; the use hereafter shall be more plainly described when I come to speake of the order of making the coffins; which shall be in the next Chapter. When you have fitted your rocket according to this direction, proceed to the making of your rammers, (or more properly called drifts) which must bee alwayes two at the least to, each mould, and as your mould increases in largenesse, so must you have more rammers, by reason of the largenesse of the taper needle: the manner and form you may see described by the letters B C.

*B is the hollow rammer, and hath a hole in it answerable to the length and bignesse of the taper needle, as appeareth in that figure. It must be a small matter lesse than the rowler, because that otherwise in putting it in, you will put down the paper, which is very prejudiciall to your rocket.*

*The other rammer is not halfe so long, and is sad, that when you have beaten to the top of the needle, you make use of it: it is described by the letter C.*

When you have fitted your rammers, you must provide a peece of Box made after the form as you see described; which must serve to make your large coffins to put the work which you intend, on the head of your rockets. It is described by the letter F, as in the figure is manifest.

*The letters E E shew the diameter, which is the just bignesse of your rocket, and must be so in all sizes.*

*G G shewes the largenesse of the coffin, and must bee two diameters, which in this figure is two inches.*

*H H H H shewes the length of the coffin, which ought to bee two diameters of your rocket, which in this place is two inches; but we are not tied to that so precisely; for we are to alter that according to the work which we put therein.*

## Chap. II.

### *How to make your coffins of paper.*

NOW having explained the manner and forme of the moulds, with the reſt of the dependants, I come now to ſhew the uſe of them in their ſeverall orders: and firſt for the uſe of the rowler, which is deſcribed by the letter A.

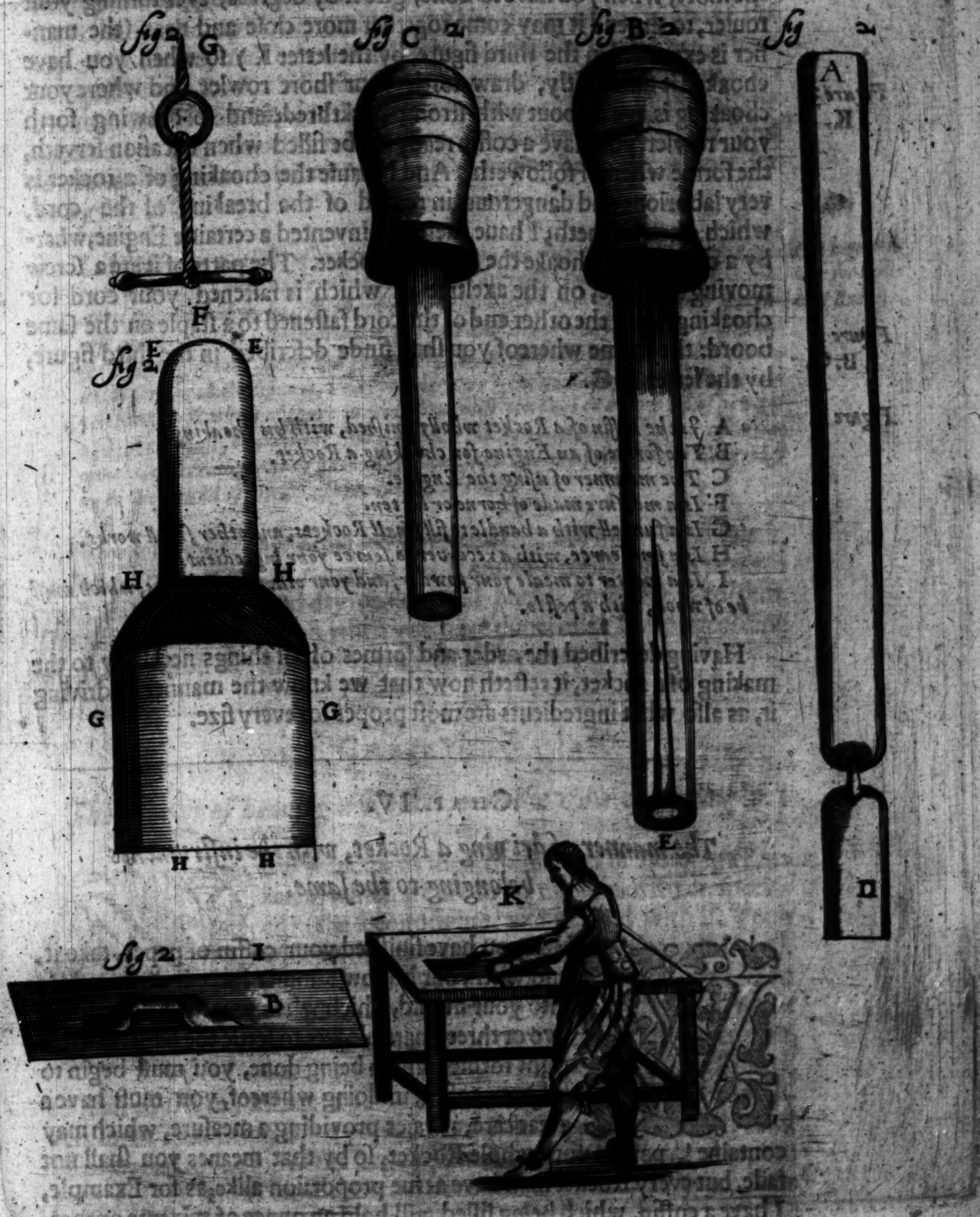
You muſt provide ſome good ſtrong paper, as old Law books, which are both ſtrong and large; and cut out your ſizes of paper for your work: now to know what length your paper muſt bee, let it bee alwayes the length of your mould: ſo ſhall you have one diameter left above the mould, the uſe whereof ſhall be ſhewn in his proper place. Now having provided your paper in length ready, take your rowler, and one length of paper, and begin to rowle; when you have rowled one ſheet, you *Figure 2. G.* muſt have a board to rowle it with (the board is marked in the ſecond figure;) which muſt be done in this manner: you muſt hold the rowler in your left hand, and with your right hold the board; then lay down your rowler upon ſome ſmooth cheſt, or table, or ſuch like; which when you have done, lay on your board, and rowle it very hard, only one way; which having done, rowle another length, and ſo proceed in rowling between every ſheet, till you have rowled on ſo much as will fill the mould very ſtraight; when you have ſo done, draw forth your rowler one diameter, which in this place is one inch; and then take the other part of the rowler, which is ſhort, and marked with D, and put it in as you ſee deſcribed; and there have you a place left for the choaking of your rocket, of which we come now to ſpeak:

## Chap. III.

### *How you ſhall choak a rocket.*

WHen you come to choak your rocket, you muſt have a ring to ſcrew into ſome poſt, at which you muſt tie your cord, which muſt be bigger or leſſer, according to the bigneſſe of your rocket, by reaſon that a ſmall cord will not choak a great rocket for want of ſtrength; and again, a great cord will not ſerve for a ſmall, in regard that it will make too great a choaking; ſo that you muſt have a bigger and leſſe; which when you have ſo provided, tying one end to the ring, you muſt about a yard off tie a ſtick, in faſhion of a handle for a ſwing, which muſt bee ſtrong, by reaſon that it muſt beare the whole weight of the body, (the letter G in the *Figure 2. K.* ſecond figure expreſſeth the ſame;) which when you have provided,

put


Fig 2
G
F
Fig 2
E
E
H
H
G
G
H
H
Fig C 2
K
E
Fig B 2
D
Fig 2
I
B
Fig 2
A
K
D

put the ſticke betweene your legges, and winde the cord about the rocket caſe in the place appointed, which is betweene the long rowler and the ſhort, when you have ſo done, girt it by degrees, ever turning your rouler, to the end it may come together more cloſe and neat (the manner is expreſſed in the third figure, by the letter K) ſo when you have choaked it ſufficiently, draw forth your ſhort rowler, and where your choaking is, tye it about with ſtrong packthred; and ſo drawing forth your rowler, you have a coffin ready to be filled when occaſion ſerveth, the forme whereof followeth. And becauſe the choaking of a rocket is very laborious and dangerous, in regard of the breaking of the cord, which often hapneth; I haue therefore invented a certaine Engine, wherby a childe may choake the ſtrongeſt rocket. The parts of it are a ſcrew moving a wheele, on the axeltree of which is faſtened your cord for choaking, with the other end of the cord faſtened to a ſtaple on the ſame boord: the forme whereof you ſhall finde deſcribed in the third figure, by the letter B. C.

*Figure 3.* K.

*Figure 3.* B. C.

*Figure 3.*

A *Is the coffin of a Rocket wholly finiſhed, with his choaking.*
B *The forme of an Engine for choaking a Rocket.*
C *The manner of uſing the Engine.*
F *Is a meaſure made of horne or latten.*
G *Is a funnell with a handle to fill ſmall Rockets, and other ſmall works.*
H *Is a fine ſearce, with a receiver to ſearce your ingredients.*
I *Is a morter to meale your powder, and your other ingredients, which muſt be of wood, with a peſtle.*

Having deſcribed the order and formes of all things neceſſary to the making of a rocket, it reſteth now that we know the manner of driving it, as alſo what ingredients are moſt proper for every ſize.

## Chap. IV.

### *The manner of driving a Rocket, with the inſtruments belonging to the ſame.*

When you have finiſhed your coffin of paper, take it, and with your hollow rammer force it downe cloſe into your mould, which when you have done, ſtrike two or three ſmart blowes to ſettle the paper into his right forme: which being done, you muſt begin to fill your coffin, in doing whereof, you muſt have a great care, alwaies providing a meaſure, which may containe $\frac{1}{20}$ part of your whole Rocket; ſo by that meanes you ſhall not faile, but every Rocket ſhall have a true proportion alike; as for Example, I have a coffin, which being filled, will hold an ounce of mixture or therabouts. I take the twentieth part, and when I finde what quantity it is, I make a meaſure of horne, which ſhall containe ſo much, and then I beginne to fill my coffin with one meaſure at a time, and putting in my ram-

rammer, ſtrike foure or five ſmart blowes with a good ſtrong mallet, and then I fill another meaſure, and ſtrike againe, ſo I continue till I come to the top of the needle, then I take the ſad rammer, and ſo continue with it, till I come to the top of the mould: now the paper which is above the top of the mould, muſt be turned downe, and beaten hard down, which being done, the Rocket is finiſhed from the mould, which force out, with as much eaſe as you can, for the leſſe you force it (being filled, and the needle taken out) the better it is, for knocking looſens the powder, and ſo cauſes the Rocket to faile: now it reſts to know the receits proper for every ſort of Rockets. *Figure 3. M.*

*And firſt for Rockets of one ounce, you may take only powder duſt, being very fine ſearced; which riſes very ſwift, but carries no taile of fire with it, and often times breakes, unleſſe they be very thicke of paper: but the beſt and ſureſt way is, to allay your powder with coale duſt being well ſearced, which cauſes a more glorious ſhew; and you may uſe it at your diſcretion. The ordinary allay for ſmall Rockets is, 1 l. of powder, two ℥. of coale duſt. Which ſerves till you come to Rockets of foure ounces, then muſt you take to every 1 l. of powder 2½ ℥ of coleduſt, continuing that quantity till you come to Rockets of tenne ounces, and from tenne to ſixteene ounces, which is one pound: your allay muſt be to one pound of powder, three ounces of coale.* The ingredients for ordinary Rockets.

Now when you have provided your powder, you muſt firſt meale it, and then ſearce it, ſo that it may be free from any corne though never ſo ſmall. Likewiſe take good dry coale, well burnt, and beat it to duſt, ſearcing it very fine, which when you have done, mixe them according as your occaſion ſerveth, and as your directions are.

## Chap. V.

### *The manner of heading a Rocket, with the order of capping it.*

NOw we come to ſhew the manner of heading a Rocket, in which we are to uſe our thicke Roler, ſpecified in the ſecond figure, and marked with F. Vpon which you muſt role ſome paper or fine paſt-board, and paſt it ſo that it may bee very cloſe, and then choake it at the length of the thicker part, ſo that it may come cloſe to your ſticke in the leſſer part, which will fit to be tyed to the top of your Rocket, ſo ſhall you have a coffine to put in your workes, which muſt bee of divers ſorts. That being done, you muſt provide Paper caps, which muſt be adjoyned to the top of the large coffin. The uſe of them is to keepe in your workes, and to cauſe them to pierce the ayre more ſwiftly. The manner of making theſe caps, is, to take a paire of Compaſſes, and deſcribe a circle in paſtboard, then cut it forth with a paire of ſheeres, and that ſhall make two cappes, being cut in the middle, and turned one corner under the other, and ſo paſted; and let them ſo paſted, be put in a napkin preſſe,

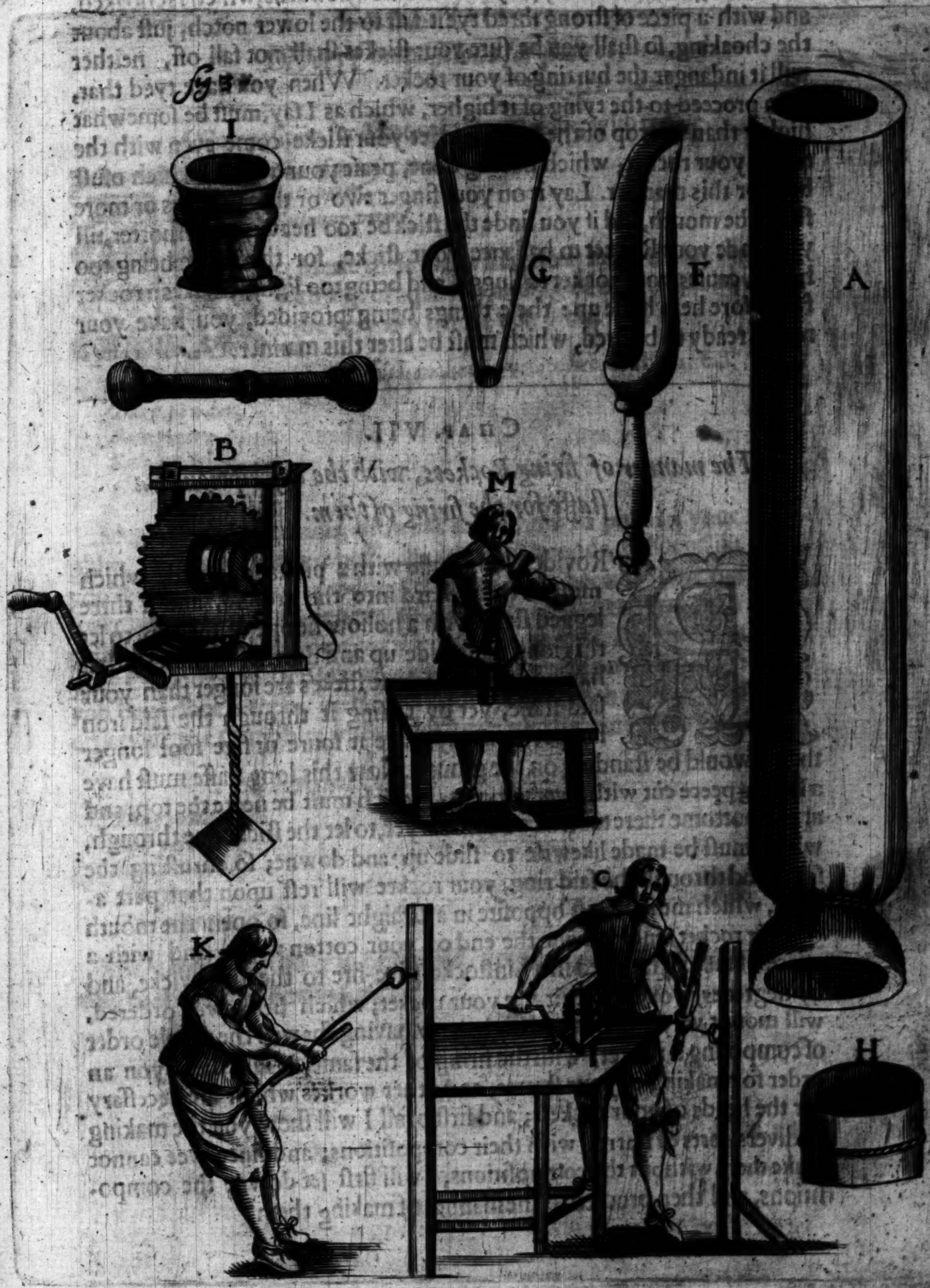
preſſe till they be dry, and when they be dry, cut out a ſemicircle in paper, which ſhall fit round about the ſaid cap, and ſhall ſerve to paſte on the cap to the coffin: the forme whereof is expreſſed in the fourth figure, by the figure 14. and 15. ſo have you all things ready to the finiſhing of your Rocket, which muſt be done as followeth.

## Chap. 6.

### *The manner of finiſhing a Rocket.*

When your Rocket is driuen, as I have ſhewed you, with the paper turned downe, you ſhall firſt prime it, which muſt be with cotton wicke made for the ſaid purpoſe, which you ſhall put up into the vent, leaving a peece to hang lower than the mouth of your Rocket, by three or foure inches, which being done, tye a piece of paper over the mouth, to the end it fall not out: now having primed your Rocket, you may proceede to the heading of it, and that is done after this manner. Take your Rocket, and on the head (where I told you, you ſhould turne downe the paper, you muſt with a bodkin, pierce two or three holes, to the intent that the Rocket having ſpent himſelfe, your workes which are on his head, may take fire; which holes, prime with a little powder duſt, and then put on his head, with the choaking fitted to your Rocket, which muſt come over the Rocket, in ſuch manner, that the bottome of the greater part muſt come even with the top of the Rocker; which tye faſt to your rocket with threed, and then put in your workes: but before you put in your workes, whether they be ſtarres, or any other workes, you muſt put in a little cotton wooll, being rowled in powder duſt, to the end your ſtars may fire, and likewiſe may blow out: which having done, put in your ſtarres, or other workes, and if you make more than one tire (as you may doe of your ſtarres) then muſt you put more cotton rowled in powder duſt amongſt them, or betweene every tire, to the end they may all take fire; then take your cap ſo provided as I have formerly ſhewed, and fill the hollow place with cotton, becauſe it is light, and likewiſe will fire quickly: which being fitted, paſte it cloſe to the top of the coffin, in ſuch manner, that it may ſtand very upright; then muſt you fit on your ſticke, for the peaſing of your Rocket, which ought to be about eight lengths of your Rocket without the head. You muſt get the ſmootheſt and lighteſt you can, ſuch as basket makers uſe; which when you have got, you muſt make very ſtrait, and then cutting one ſide of it, flat at the great end, make two notches on the round ſide, provided that the one be differing from the other, ſo much as is betweene the choaking of your Rocket, and the end of the vent; becauſe if you ſhould tye it upon the vent, it would looſen the powder, and ſo cauſe it to breake in the firing. Now that you tye not the wrong end of your

Rocket


I
G
F
A
B
M
K
C
H

Rocket uppermoſt, as ſome fooliſhly have done, for want of better inſtructions, you muſt alwayes tye the end downewards, which is choaked, and with a piece of ſtrong thred tye it faſt to the lower notch, juſt about the choaking, ſo ſhall you be ſure your ſtickes ſhall not fall off, neither will it indanger the hurting of your rocket. When you have tyed that, then proceed to the tying of it higher, which as I ſay, muſt be ſomewhat higher than the top of the vent, and let your ſticke come even with the top of your rocket; which having done, peaſe your rocket, which muſt be after this manner. Lay it on your finger two or three inches or more from the mouth, and if you finde the ſtick be too heavy, cut it ſhorter, till you finde your Rocket to ballance your ſticke, for the ſticke being too heavy, cauſes your rocket to ſlugge, and being too light, it makes a rocket fall before he is halfe up: theſe things being provided, you have your rocket ready to be fired, which muſt be after this manner.

## Chap. VII.

### *The manner of firing Rockets, with the deſcription of a ſtaffe for the firing of them.*

PRovide a long ſtaffe with a pike at one end, which muſt be thruſt hard into the ground, and a three legged ſtaffe with a hollow hoope at the top, to let this long ſtaffe ſlide up and downe, to the end that having rockets, whoſe ſtickes are longer than your ſaid ſtaffe, yet by raiſing it through the ſaid iron hoope, you may make it foure or five foot longer than it would be ſtanding on the ground. Now this long ſtaffe muſt have a ſliding peece cut with ſeverall points, which muſt be neere the top; and at the bottome there muſt be a ring of wyer, to let the ſticke goe through, which muſt be made likewiſe to ſlide up and downe; ſo thruſting the ſmall end through the ſaid ring, your rocket will reſt upon that part above, which muſt be juſt oppoſite in a ſtraight line, ſo open the mouth of your rocket, and pull out the end of your cotton wicke, and with a peece of match, faſtened in a Linſtocke, give fire to the ſaid wicke, and by degreees, you ſhall ſee it fire your rocket; which being well ordered, will mount very ſtraight and high: now having ſhewed the whole order of compoſing a rocket, with the firing of the ſame, I will ſhew you an order for making of your ſtarres, and other workes which are neceſſary for the heads of your rockets; and firſt of all I will ſhew you the making of divers ſorts of ſtarres, with their compoſitions; and ſince wee cannot make them without the compoſitions, I will firſt ſet downe the compoſitions, and then proceed to the manner of making them.

## Chap. VIII.
## *Divers Compositions for starres.*

A Composition for starres of a blew colour, with red.

*Take of powder mealed,* 8 ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ
*Salt peter,* 4 ℳ ℳ ℳ ℳ
*Sulphur vive,* 12 ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ

Meale these very fine, and mixe them together with 2 ℥. of aqua vite, and ½ ℥ of oyle of spicke, which let be very dry before you use it.

Another Composition which maketh a white fire and beautifull.

*Take powder,* 4 ℳ ℳ ℳ ℳ
*Salt peter,* 12 ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ
*Sulphur vive,* 6 ℳ ℳ ℳ ℳ ℳ ℳ
*Camphire,* ½ ℥

Meale your ingredients, and mixe them; now to powder your Camphire, you must dip your pestle in oyle of Almonds, or such like oyle: you must not use your wooded pestle for this, because that oyle will soake into it, which is an enemy to some workes, therefore take a brasse pestle and morter, and dipping the pestle in oyle of Almonds, put it to your Camphire, and so stirring it by degrees, it will powder; which when you have done, keepe it very close from ayre, till such time as you use it, otherwise the Camphire will lose his spirit, and become of no use.

Another white fire which lasteth long.

*Take powder,* 4 ℳ ℳ ℳ ℳ
*Salt peter,* 1 ℳ ℳ ℳ ℳ
*Sulphur vive,* 2 ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ
*Camphur,* 1 ℳ ℳ ℳ ℳ
*Oyle of peeter,* 3 ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ ℳ

Meale those which are to be mealed, very fine, and mixe them according to the former directions.

Chap.

## CHAP. IX.

### *The manner of making the beſt ſort of ſtarres.*

NOw having ſet downe the compoſitions for ſtarres, it reſteth to know how theſe ſtarres are made, which is divers waies, but I will ſet you downe onely two waies both which are very good, ſo that you may take your choyce. The firſt is this, you muſt make little ſquare pieces of browne paper, which fill with your compoſition you intend, and ſo double it downe, rolling it till you make it ſomewhat round, about the bigneſſe of a nut or bigger, according to the ſize of your rocket; you may put in a dozen on the head of a ſmall rocket; when you have made them up in this forme, you muſt binde them round with ſmall thred, which done, draw through a cotton wicke prepared for priming, as hereafter ſhall be ſhewne.

*Figure 4. N. G.*

The ſecond ſort are made after another manner, which is thus; you muſt have a rowler, as big as an ordinary arrow, which ſhall be to rowle a length of paper about it, and with a little mouth glue, or paſte, paſte it round; ſo have you a hollow trunke of paper, which you ſhall order after this manner. Fill it by little and little with your ſmall funnell, ſtill thruſting it very hard, till you have filled it to the top; which done, cut it into ſhort pieces, about halfe an inch in length; then having in readineſſe either hot glue, or ſize mingled with red lead, dip one end of your ſhort pieces, to the end, that both ends of your ſtarre fire not, and alſo that it may not blow out; which being ſo finiſhed, ſet to dry till you uſe them, and then putting the other end into powder duſt, you may put them on your rocket, in one or two tier; alwaies provided, as I ſaid before, that you put in powder duſt betweene every tier, to the end they may all fire; thus have you the manner of making your ſtarres, the formes whereof you ſhall have deſcribed hereafter.

*Priming for Rockets.*

The priming before ſpoken of, is made after this manner; take oyle of Camphire, and ſoake ſome cotton wicke in it, then take it out being moyſt, and rowle it in fine powder duſt, which having done, you ſhall hang it up till it be thorow dry, ſo have you prepared a very good priming, which muſt be kept cloſe from ayre, till ſuch time you have occaſion, otherwiſe the ſpirit of the Camphir will decay.

The deſcription of the ſtaffe for firing of Rockets.

A *The long ſtaffe to riſe through the ring.*

BBB *The three legd ſtaffe.*

C *The ring or hoope of iron for the long ſtaffe to ſlide thorow.*

D *A ſcrew to ſcrew faſt the long ſtaffe being raiſed.*

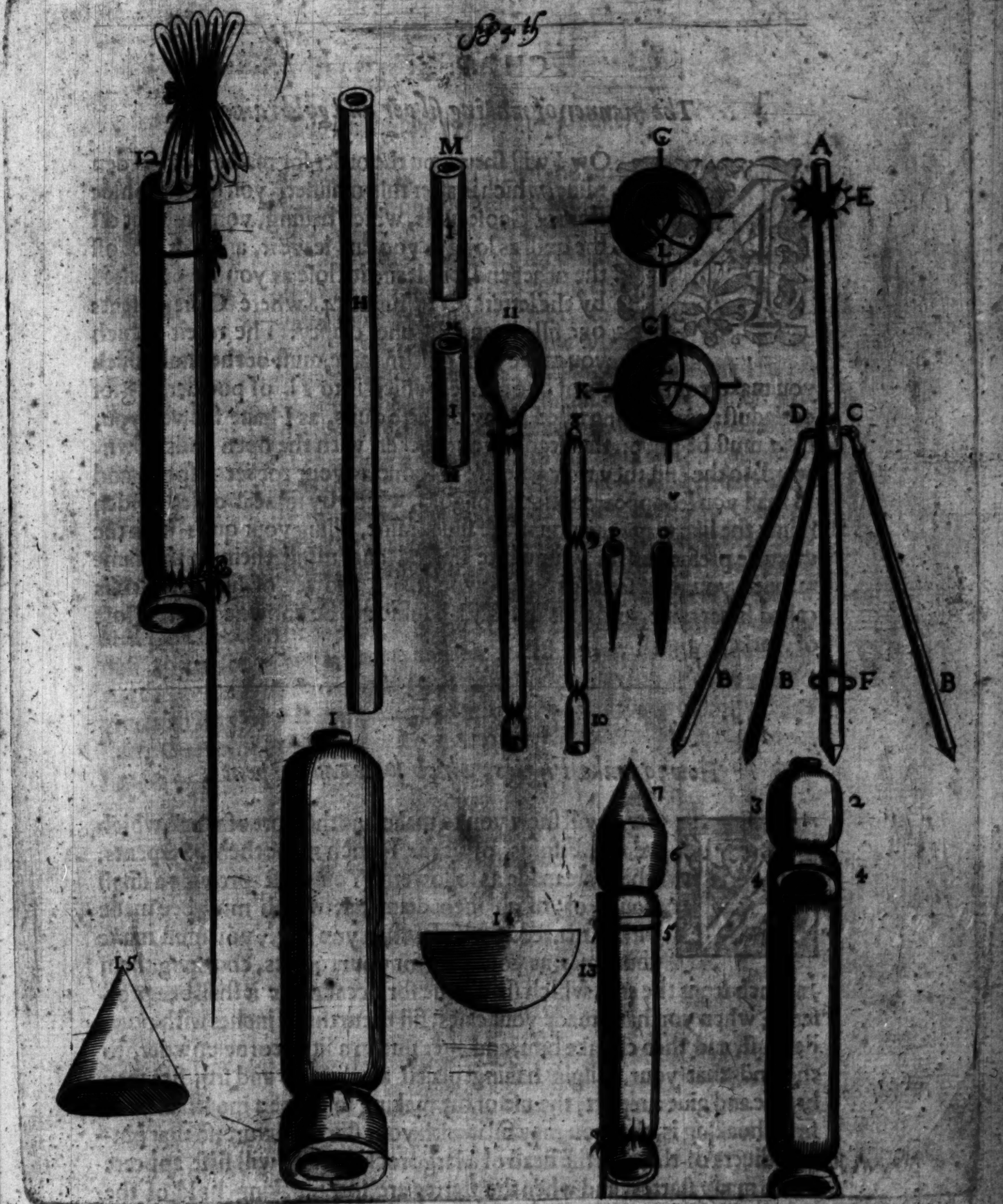
E *A piece of iron filed with notches to hang the Rockets on.*

F *The ring of wyer to put thorow the ſticke, which may be raiſed higher, or put lower, as occaſion proffers.*

GG *The deſcription of two ſtarres, with the priming,* K, *and the binding* L.

H *The deſcription of the trunke, or caſe, which is to be filled with your ſtar mixture, and ſo cut into ſhort pieces, as you ſee repreſented by the figures* I. I.

*where*


M
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L
II
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C
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B
F
B
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4
4
5
14
13
15

*where the uper part represents the open end, and is marked with* M, *and the under part which is glued, is represented by the letter* N, *so have you the ſtarres wholly deſcribed.*

## CHAP: X.

### *The manner of making ſilver and gold raine.*

NOw I will ſhew you the order for making of golden raine, which is after this manner; you muſt prouide ſtore of Gooſe quils, which hauing, you muſt cut off the quill as long as you can leaue it, and cut not off the other end, but leaue it cloſe as you ſee preſented by the letters OP. Figure 4. where O repreſents one filled, and P one empty. The receit which you make your golden raine, muſt be the ſame which you make your rockets of one ounce, which is to 1 l. of powder, 2 ℥. of coaleduſt: now hauing filled many of theſe quils, as I haue ſhewed you, they muſt be put on the head of your rocket, with the open ends downward, to the end they may take fire ſo ſoone as your rocket is ſpent, and ſo ſhall you ſee appeare a ſhower of gold, which by ſome is called golden raine: the like way may you make ſiluer raine, filling your quils with the mixture preſcribed for your white ſtarres, and uſing them in the ſame manner, you ſhall ſee them fall downe like a ſhower of ſiluer, which is called ſiluer raine, and thus much ſhall ſuffice to be knowne for this ſort of worke.

## CHAP. XI.

### *How to make Fiſgigs, which ſome call Serpents.*

NOw I will ſhew you to make another ſort of work, which we call Fiſgigs, or as the French name them, Serpents, which are made as followeth. You muſt prouide a ſmall mould, of ¼ of an inch diameter, which muſt bee made without a needle, which when you haue, you muſt make your caſes, as you make for your rockets, choaking them ½ an inch from the end, which ſhall ſerue for occaſion as it ſhall bee proffered; when you haue made your caſes, fill them three inches with powder duſt, and then choake him, and after put in a little corne powder, to the end that your Fiſgig hauing plaied a while to and fro, hee may breake and giue a report; the uſe of the making ſo deepe a mouth at your firſt choaking is, that you may fill it with your ſtarre mixture; ſo that putting diuers of them on the head of a large rocket, they will firſt appeare like ſo many ſtarres, and when the ſtarres are ſpent, taking hold of the powder duſt, they will run wrigling to and fro like Serpents, and after a while they will giue ſo many reports, which will giue great content.

There

There are many works which are made of theſe fisgigs, which wee will ſpeak of in their places.

## CHAP. XII.

### *How to make the reports or breakers.*

NOW I will proceed to ſhew the manner of making reports to place on the head of a rocket; you muſt make a coffin of the ſize of your rocket of one inch, but you muſt rowle your paper a great deale thicker, to the intent your report may be the greater; alſo in choaking, the mouth muſt bee left very large, to the end that on occaſion you may fill it with ſtarre mixture; now when you have made divers coffins about three inches and better in length, you muſt leave a ſmall vent at the choaking, the bigneſſe of an ordinary wyer, which you muſt ſtop with a little paper, while you fill the coffin almoſt full, or within halfe an inch of the top, with good corn powder, turning down foure or five folds of paper, choak it cloſe at the top, and binde it round with thred, ſo you have your reports ready, againſt ſuch time you come to uſe them; which muſt be done in this manner: firſt bee carefull to pull out your ſtopple, which having done, fill the mouth with your ſtarre mixture, and ſo faſten him on the top of your rocket, alwayes putting a little paper about the top of your rocket, and in it put a little powder duſt, and ſo ſet on your report, and tie it faſt on, with the mouth towards the head of the rocket, ſo that the rocket having ſpent himſelfe, you ſhall ſee a large ſtar appeare, and when it is neere the ground, you ſhal heare the report; the order thereof you ſhall finde deſcribed in the fourth figure.

1 *Is the report ready finiſhed.*

2 *The rocket with the report on the head.*

3 *The report faſtned on the head of the rocket.*

4 *The paper to faſten the report to the rocket, which muſt firſt bee tied to the rocket, and likewiſe to the report.*

8 *Repreſenteth a fisgig finiſhed.*

9 *The choaking, as I have ſhewed, which muſt bee filled upward with corn powder.*

10 *The mouth of your fisgig, which upon occaſion you may fill with your ſtarre mixture, to put on the head of your rockets.*

11 *Repreſenteth a fiſgig, with a bladder, which muſt be tyed on to the head of them, in ſuch manner, that the neck of the bladder may go into the fisgig, and ſo be faſt tyed, that they ſtirre not; the uſe of them is, only to fire in your hand, (for being fired with a little powder duſt in the mouth of it) and ſo caſt away from you, it will fly to and fro without ceaſing, till it hath ſpent it ſelfe; and by reaſon of the bladder which is tied to it, it will not ſtick faſt to the ground, as others do which have no bladders.*

12 *Repreſenteth a cracker faſtned to the top of a rocket, ſo that the rocket having ſpent himſelfe, it taketh fire, and maketh many reports; the manner*

*of faſtning him is thus ; you muſt firſt tie on your rocket, leaving the ſtick ſo much higher than the top, as will ſuffice to tie on your cracker, which muſt be tied about the ſaid ſtick, in ſuch manner, that the noſe of it may come into the head of your rocket, which be ing primed with ſome powder duſt, will take fire.*

*5 Repreſenteth a rocket with ſeverall works, whether ſtarres, or ſerpents, and muſt be with a large coffin on the top, with his cap.*

*6 Is the coffin, which as I have ſhewed you, muſt bee ſomewhat bigger than your rocket.*

*7 Is the cap, which muſt be taper.*

*13 Sheweth the faſtning of the ſtick, which muſt not bee higher than your rocket, beſide the large coffin.*

All which I have formerly deſcribed, with the form and manner of making them, and their ſeverall uſes; ſo that I have fully layd down the whole order of finiſhing a rocket for the ayre. Now it reſteth to ſhew what other works may bee done by the ſayd rockets, which are many; for all ſorts of Fire works for pleaſure, do wholly depend upon them, except the water bals: and to proceed, I will firſt deſcribe unto you the order of making the runners on the line, which muſt bee done in manner following.

## CHAP. XIII.

### *How to make a runner on the line.*

YOV muſt provide a ſmall rocket mould, which muſt be halfe an inch or more, with rowlers, and rammers, according as I have deſcribed, ſave only that your mould muſt have no needle, nor your rammers hollow; when you have provided them, make up your caſes, after the form which I have ſhewed you, ſome longer, and ſome ſhorter, which muſt be uſed as followeth; your ſhort ones muſt be beaten up to the top, which muſt not bee above foure inches; your longer, which muſt bee 5 inches, muſt bee likewiſe filled foure inches high, and the reſt to be filled with corn powder within halfe an inch of the top, which muſt be choaked cloſe, and tied up; the receipt for theſe ſorts muſt be only fine powder duſt.

*Receipt for runners.*

Now when you have driven them as is ſhewed, you may proceed to the finiſhing of them, which muſt be in this manner; you muſt rowle a peece of paper about the head of your ſhorter rocket, (which muſt be left open to give fire to the next) which paper muſt be five inches broad, and being rowled on, you muſt firſt try if the mouth of your other rocket will eaſily go in, which when you have done, draw forth your other rocket which you tried, and binde your paper faſt to the top of your ſhort one, in ſuch manner, that foure inches may remaine hollow above the top of your rocket, which is to be filled with powder duſt, about two

inches

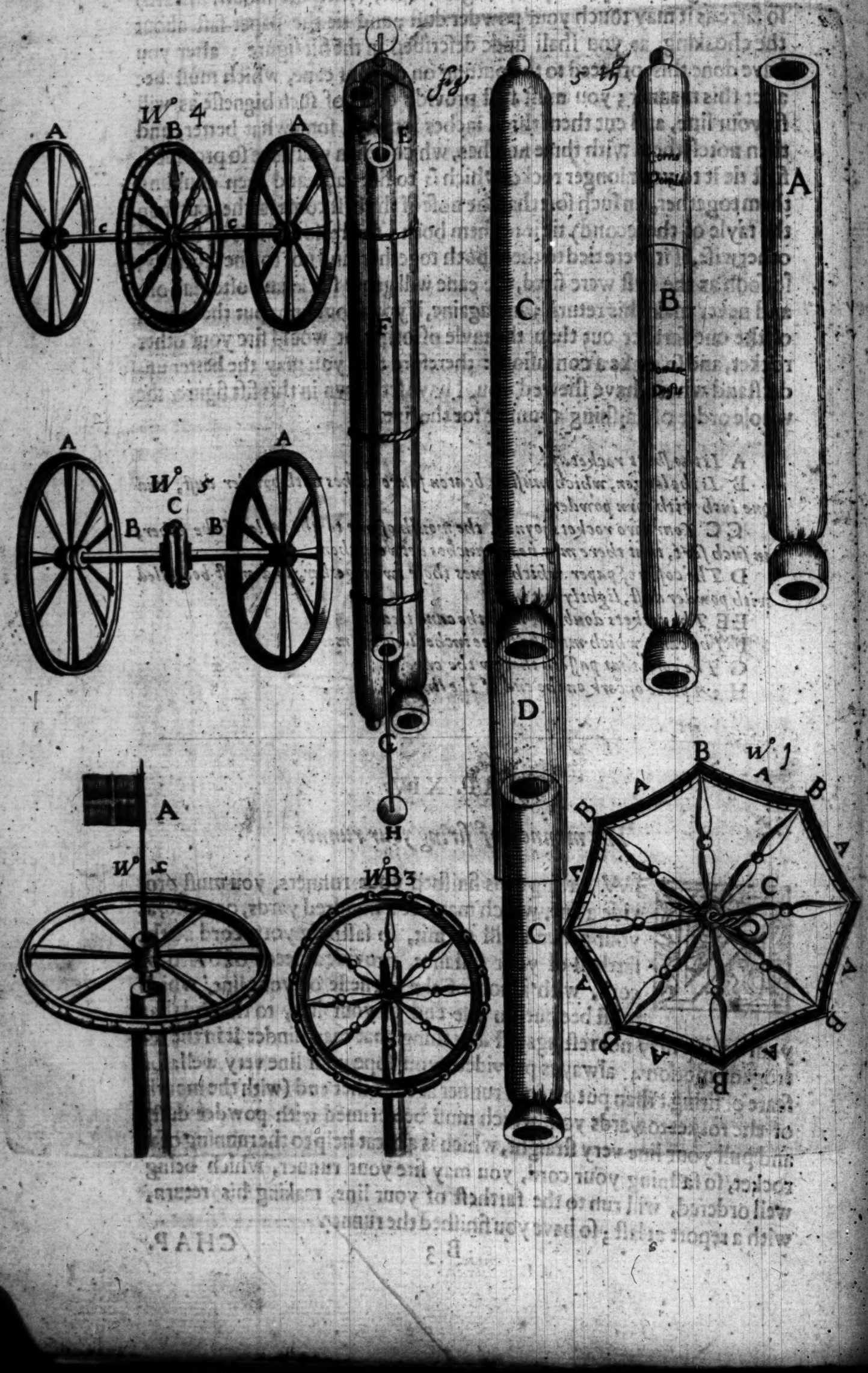
inches high; then put in your longer rocket, (with the mouth inward) so farre as it may touch your powder dust; and tie the paper fast about the choaking, as you shall finde described in the fift figure; after you have done this, proceed to the putting on of your cane, which must bee after this manner; you must first provide canes of such bigneſſe as will fit your line, and cut them three inches long, or somewhat better, and then notch them with three notches, which when you have so provided, first tie it to your longer rocket which is to fire last, and then doubling them together, (in such sort that the nose of the first come farther out than the tayle of the second) tie it to them both; the reason of this is, because otherwise, if it were tied to them both together, and not to one severally, so soon as the first were fired, the cane will grow slack, and often fall off, and never make his return; and againe, if you should not put the mouth of the one farther out than the tayle of other, it would fire your other rocket, and so make a confusion: therefore that you may the better understand what I have shewed you, I have set down in this fift figure, the whole order of finishing a runner for the line.

A *Is the short rocket.*
B *Is the longer, which must be beaten foure inches with powder dust, and one inch with corn powder.*
CC *Your two rockets joyned, the mouth of one to the tayle of the other, in such sort, that there may be two inches between them.*
D *The coffin of paper which joynes those two together, and must bee filled with powder dust, lightly put in.*
EE *The rockets doubled, with the cane tied on.*
F *The cane, which must be three inches long, or more.*
G *The cord that passeth thorow the cane.*
H *A peece of cork on the end of the line.*

## CHAP. XIV.

### *The manner of firing your runner.*

NOW having thus finished your runners, you must provide a line, which may bee a hundred yards, or more, as your ground will permit, so fastning your cord at the farthest of your distance, provide a peece of board or cork, with a hole of the bigneſſe of your line, which must bee put on the end of your line, to the end that your rocket may not rest against any thing that may hinder it in the retrograde motion; alwayes provided, you sope your line very well, for feare of firing: then put on your runner at the other end (with the mouth of the rocket towards you, which must bee primed with powder dust) and pull your line very straight, which is a great help to the running of a rocket, so fastning your cord, you may fire your runner, which being well ordered, will run to the farthest of your line, making his return, with a report at last; so have you finished the runner.


A
B
A
W° 4
c
c
E
F
A
A
W° 5
C
B
B
A
W° 2
H
W° 3
C
D
C
A
B
B
A
A
A
B
B
A
A
A
B
B
A
A
B
W° 1
C

## CHAP. XV.

### *How to compose a wheele.*

NOW I will shew you the order of composing a wheele, which is a prime work, being well ordered; of which some are movable, and some immovable: of the movable, some move horizontall, and some verticall, which is toward the zenith: and first of the movable wheele. You must provide a wheele of such diameter as you please, which must be made into squares, according to the circumference of your wheele, and to proportion your wheele into a just number, you may allow five inches or better for every side, so that your wheele being 14 inches diameter, the circumference will be as 7 to 22, which is 44 inches circumference; so being divided by 5, there will bee 8 squares, or more properly, 8 sides, which will every one containe 5 inches and $\frac{1}{10}$, which is the cord of 45 degrees; these sides must bee hollowed with a groose fitting your rockets, and at the ends of every side it must bee filed with notches, to fasten your binding that it slide not, when you binde fast your rockets; the form whereof you shall finde in the fift figure N 1. *Figure 5. N 1.*



A *Sheweth the 8 sides.*
B *The places of fastning.*
C *The screw which fastneth the wheele to some post.*

Note alwayes, that as your wheele doth increase in diameter, so you must increase in the proportion, for that rocket which forces about a wheele of 14 inches, will not force a wheele of 18 inches; nor that rocket which forceth one of 18 inches, will not force one of 24 inches; but that you may come to a neere proportion, I will satisfie you so neere as I can; first seek the diameter of your wheele, which imagine to bee 18 inches, I take the third thereof, which is 6, so that your rocket for 18 inches diameter, must be 6 inches long, and your wheele of 24 inches diameter, will require rockets of 8 inches; yet as your wheele encreaseth, you may alter this proportion by dividing it into more sides.

Now having provided your wheele, with your rockets of a just size, you shall proceed to the finishing of it, which must bee after this manner; you must joine your rockets one to another, in such sort as I shewed you for your runners, that is, with the mouth of the one to the top of the other, and so proceed till you have fastned so many as will serve your wheele, alwayes leaving so much space between each rocket, as may suffer them to come round about your wheele, without breaking any; which when you have done, proceed to the tying of them on to your wheele, which must be so ordered, that you tie them where the notches are, to the end they faile not in firing, by sliding off. In tying them on you must provide that you leave a little distance between the first and the last, which must be parted with a bolster of paper well soaped, to the

end

end that the first fire not the last, and so cause a great confusion. Now for the manner of placing them, it is according to the workmans pleasure, which must be either horizontall, or verticall; for the horizontall wheele you must provide a post fastned in the ground, and screw your wheele to the top of it; for the verticall, you must screw it on the side of the post, so having fired them, you shall see one run parallell to the horizon, and the other to the zenith, as you shall see described in the fift figure.

N 2 *Representeth the horizontall wheele.*
N 3 *Representeth the verticall wheele.*

There are many other works which do wholly depend upon the wheele, of which I will set down some few.

## CHAP. XVI.

### *How to make a ground wheele.*

HEre I will declare unto you the manner of making a paire of wheels to run upon a plain horizon; provide two wheels, (such as are spinning wheels) of one bignesse, which must bee fastned to a small axeltree, in such manner, that they may not move about the axeltree, and on the middle of the axeltree fasten a fire wheele, which let bee so much lesse than the other, that it touch not the ground, so that being fast upon the same axeltree, it cannot run unlesse it carry the other with it, which being set on a plain horizon, will run a great way without ceasing: now that you may make it return, you may provide your wheele in such manner, that it may have rockets on both sides, so that one side being spent, it may give fire to the other, which being fastned with their mouthes the contrary way, will make a return with a swift motion.

The form of these ground wheeles you may see represented in the fift figure, N 4.

A A *the two wheeles fastned to the axeltree.*
C C *the axeltree on which the three wheeles are all fastned.*
B *the fire wheele, which is represented of a lesser diameter that the other two.*

CHAP.

## CHAP. XVII.

### *Another manner of ground wheeles.*

THere is another kinde of ground wheeles, and that is made ſo, that the wheeles may move about the axeltree; but this ſort is not moved about by a wheele, in regard the axeltree muſt ſtand ſtill, but it is made after this manner; you muſt make your axeltree ſomewhat broad about the midſt of it, and in that place you ſhall boare two holes, into which you ſhall put two rockets, which muſt bee ſo cloſe one to the other, that they may almoſt touch, and muſt bee ſo joined together, that one having ſpent himſelfe, the other may take fire, after the manner of your line work, to the end that being fired, it may run firſt one way, and then the other taking fire, may make his return by a ſecond motion: now the rockets which you put into this place, muſt alwayes bee proportioned according to the bigneſſe of your wheele, which if you perform according to the direction, you ſhall have your deſire.

The form of this wheele is expreſſed in the fift figure N 4.

A A *the two wheeles being looſe upon their axeltree.*
B B *the axeltree in which the rockets are put.*
C *the place for the two rockets to be faſtned, which muſt be ſo ordered, that the mouth of one may joyne to the tayle of the other.*

It is eſpecially to be noted, that theſe wheeles muſt run upon a very plain horizon, ſuch as the place for the game of Pall Maile at St. *Iameſes*, or ſome other very ſmooth place; by reaſon that after the firſt firing of a rocket, his violence is over, and ſo a ſmall thing will ſtay him.

There are alſo ſundry ſorts of wheeles, which do perform divers offices; ſome for diſplaying of a Coat of Armes, and others for ſetting of divers circular works, ſome of them I will ſpeak of; and firſt I will ſhew the manner of making a horizontall wheele, which with one firing ſhall give divers reports, and ſhall ſtand fixed.

CHAP.

## Chap. XVIII.

### *The manner of making a fixed wheele, which ſhall give divers reports.*

YOV muſt firſt get a wheele turned by ſome workman, which muſt be two foot in diameter, (or as you pleaſe to augment or diminiſh your work) which muſt have a grooſe turned out of the upper ſide, of halfe an inch wide, and likewiſe as deep; to which grooſe you muſt have a peece of wood ſo fitted, that it may juſt ſlide in, which peece of wood muſt have ſo many ſmall holes bored in it as you will have reports about it, alwayes provided, you ſet them not too neere together, becauſe the firing of one may not beat down the other; when you have thus provided your wheele, make a conveyance or hollow trunck of paper which will iuſt fill it, which muſt bee filled with ſome of your ſlow mixtures for ſtarres, and then putting on the cap of wood ſo fitted with holes, and made very faſt with glew, pierce every hole into your hollow conveyance, ſo that putting a quill into every one, they may take fire, and to the ſaid quill faſten a report, ſo ſhall you have a peale of Chambers placed in a ſmall roome, which being once fired, will follow in order till the whole train be ſpent. The form you ſhall ſee expreſſed in the ſixt figure marked A.

*Figure 6. A.*

## Chap. XIX.

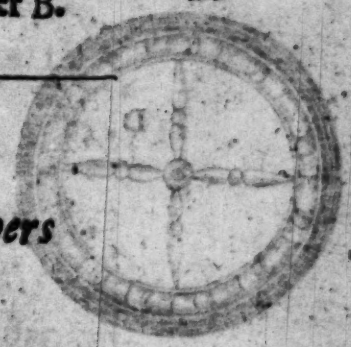
### *How to make a fixed wheele which ſhall caſt forth many rockets into the ayre.*

THere is likewiſe another ſort of wheele not much unlike to the former, which ſhall give fire to divers rockets ſtanding circular, the order differs nothing from the former, only you muſt make a hole for every ſtick to paſſe thorow, and therefore it muſt be made ſomewhat broader, which will effect the ſame as the other doth, by conveying fire from one rocket to another, till they bee all ſpent; the mixture for this conveyance ought to bee very ſlow, wherefore I adviſe you to take this enſuing, which is both ſlow and ſure:

*Take Roch peter,* 8 ℥
*Sulphur vive,* 4 ℥
*Camphire,* ℥ ß
*Fine powder duſt,* 2 ℥

Meale

Meale theſe ingredients very fine, and incorporate them, adding ℥ of Linſeed oyle, and ℥ of oyle of peter; theſe oyles muſt be dropped in by degrees, and ſo wrought up, till you finde your mixture bound like dough, which if you performe well, will bee both ſlow and ſure. The forme of this wheele is expreſſed in the ſixth Figure, by the letter B. *Figure 6.* B.



## Chap. XX.

### *How to make a fixed wheele, which ſhall caſt forth divers Fiſgigs, and likewiſe as many reports or breakers.*

CAuſe a wheele to bee turned, with a grooſe on the top to put in your conveiance of paper; then fit on a peece of wood, as I have formerly ſhewed you, with ſmall holes to put in quils, which are for the firing of your reports, and muſt bee placed round about the uper part of your wheele; and on the ſide thereof, ſhall be made diuers holes of the bigneſſe of your Fiſgigs, (which ſhall be ſo pierced thorow to the paper conveiance) thoſe fiſgigs that are placed round on the ſide, & the reports on the top, one traine ſhall fire them all, and in firing, you ſhall ſee all the Fiſgigs flying round about, one after another, as the fire paſſeth to them; and for every Fiſgig which paſſeth out, ſhall bee fired a report, ſo that there ſhall be a continuall motion untill the whole traine bee conſumed: the forme of this wheele is repreſented in the ſixth Figure, by the letter G.

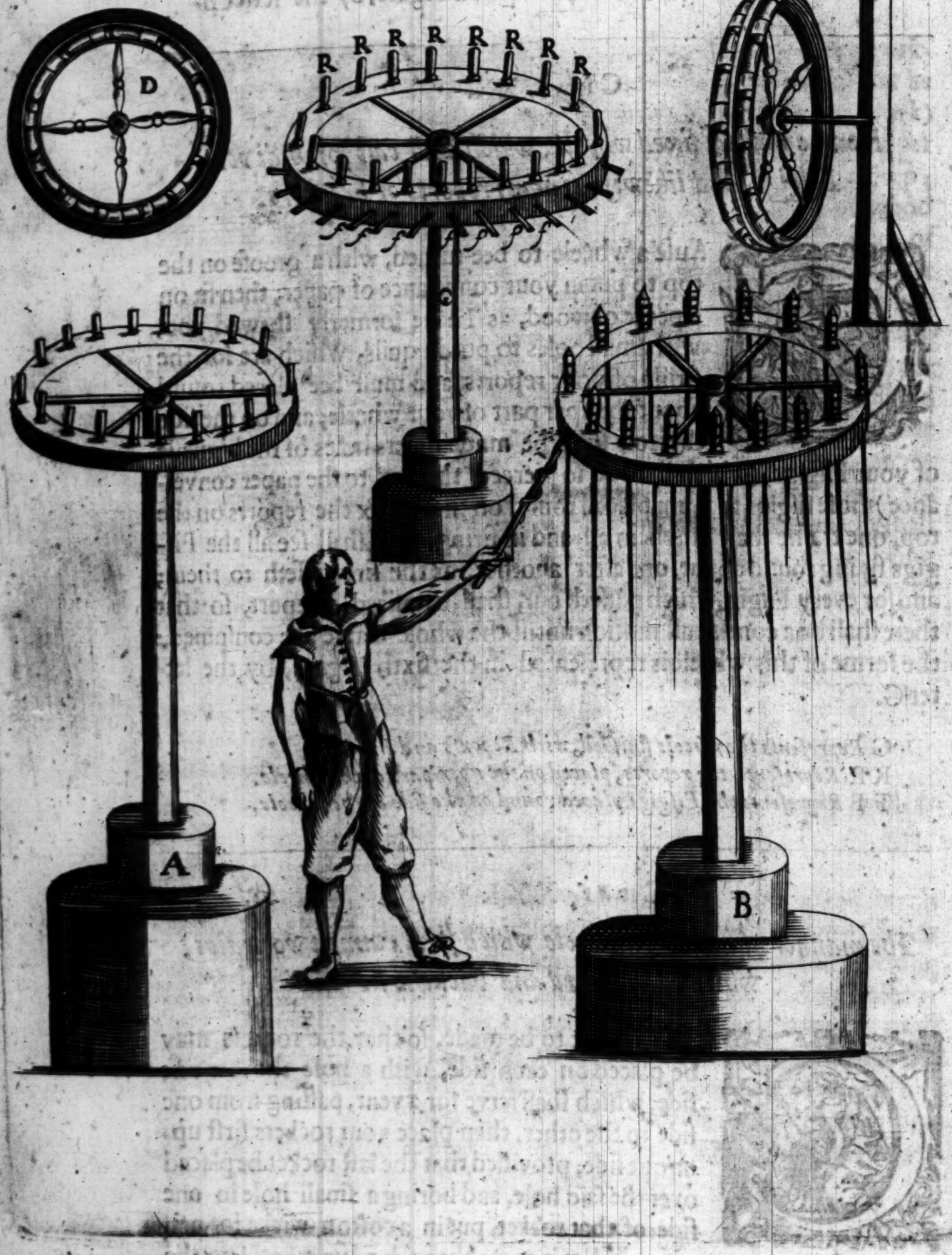
G *Repreſents the wheele finiſhed, with Reports and Fiſgigs.*
R R *Repreſents the reports, placed on the uper part of the wheele.*
F F *Repreſents the Fiſgigs placed round on the ſide of the wheele.*

## Chap. XXI.

### *The manner of making a wheele which ſhall rume two waies, which is, forward and backward.*

CAuſe a wheele to be made, ſo that the rockets may be placed on each ſide, with a hole thorow one ſide, which ſhall ſerve for a vent, paſſing from one ſide to the other, then place your rockets firſt upon one ſide, provided that the laſt rocket be placed over the ſaid hole, and boring a ſmall hole in one ſide of that rocket, put in a cotton wicke for priming, and let it come through your wheele, to the mouth of another rocket, which ſhall bee turned the contrary way; ſo that the wheele having finiſhed his revolution one way, may take fire on

Fig 96



on the other ſide, and ſo make a retrograde motion: and as you doe this, ſo may you after the ſame manner, make a wheele which ſhall runne direct, and continue twiſe ſo long as another of the ſame bigneſſe, which is by placing the rockets the ſame way on both ſides. The forme of this is expreſſed in the 6 Figure, by the letters D and E.

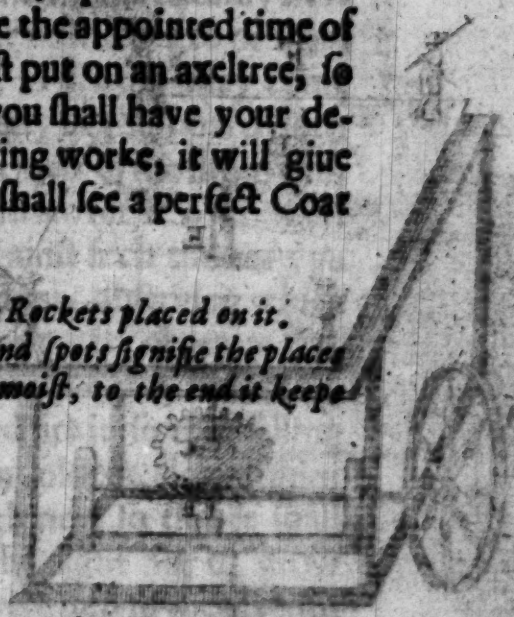
D *Repreſents the wheele with Rockets placed on the one ſide, the laſt rockets having a vent, to paſſe through to the other ſide.*
E *Repreſents the ſaid wheele finiſhed with Rockets on both ſides.*

## CHAP. XXII.

### *The manner of compoſing a wheele, which having finiſhed his revolution, ſhall repreſent a Coat of Armes.*

MAke a wheele of ſome light board, ſo that it may be without any ſpoakes, and upon one ſide of it, let be drawne, that Coat of Armes you intend to repreſent, then boare ſo many holes in the wood, as may conveniently ſtand on the traced lines, then on the other ſide, neere the top, ſhall a place bee made, which may containe your rockets, with a hole pierced thorow where the laſt rocket muſt reſt. This being done, place your rockets round about, ſo that the laſt rocket may be placed on the vent which muſt bee primed carefully, to paſſe thorow to the other ſide, having placed on the rockets, fill thoſe holes on the other ſide with ſome ſlow mixture, ſuch as is for your ſtars, or the like, then cover it over with paper, and put in ſome powder duſt to fire it, and to break the paper, which being done, ſope it well over for feare of ſome ſparkes lighting on the paper before the appointed time of firing, ſo have you a wheele ready which you muſt put on an axeltree, ſo that it may ſtand verticall, and then firing it, you ſhall have your deſire, for ſo ſoone as the wheele hath ſpent his moving worke, it will giue fire to the other ſide; and then ſtanding ſtill, you ſhall ſee a perfect Coat of Armes in fire. Figure 7. A. B.

A *Repreſents that ſide of the wheele which hath the Rockets placed on it.*
B *Repreſents the Coat of Armes, in which the round ſpots ſignifie the places to be filled with a ſlow mixture, which muſt bee moiſt, to the end it keepe cloſe in.*



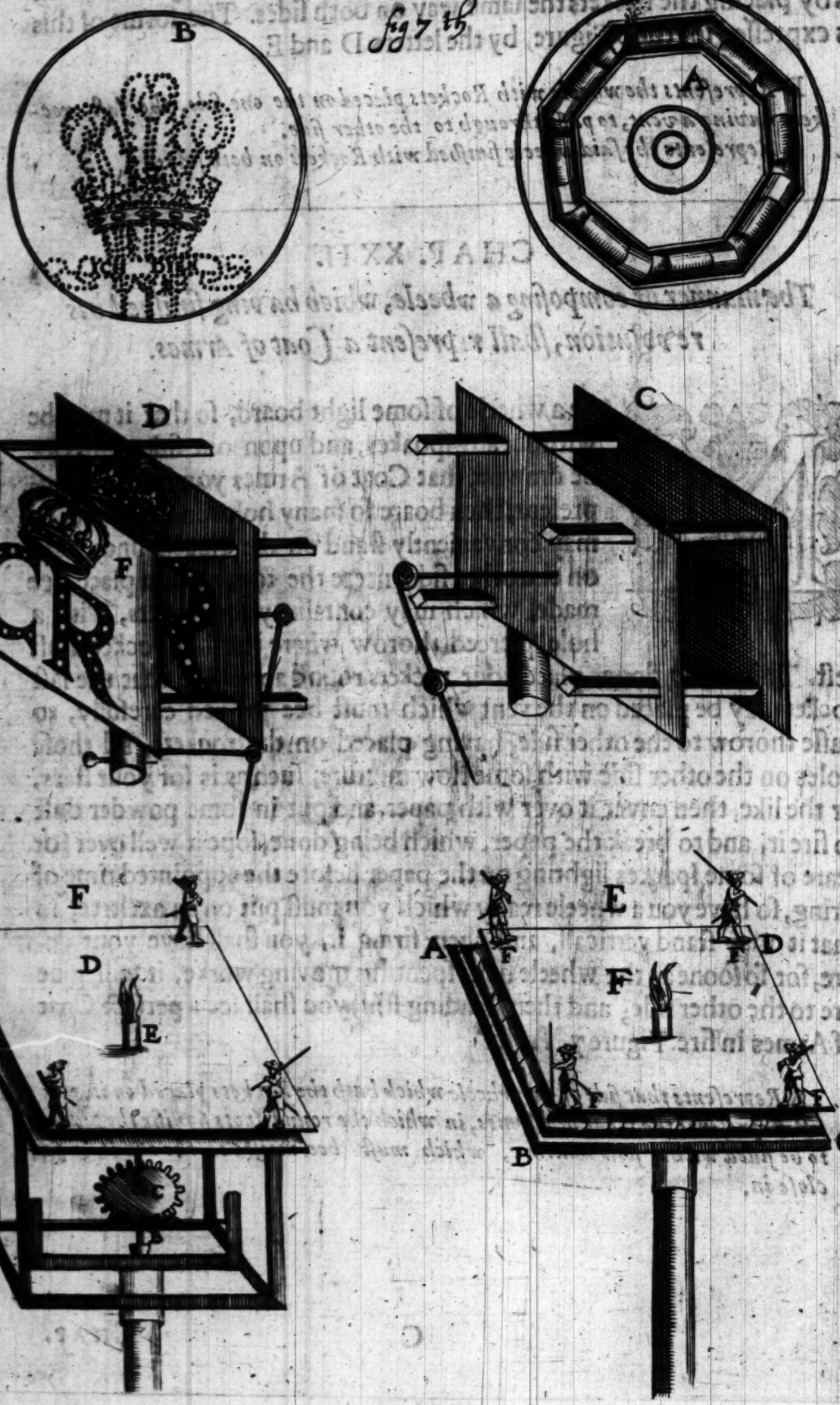



Fig 7th

## CHAP. XXIII.

### *How to represent a Coat of Armes in fire, which having burnt a small while, the said Coat shall appeare in his perfect colours, and shall continue so a long while.*

FIrst cause a board to be made foure square, of what dimension you please, which let be ½ an inch thicke, and cause a Painter or some drasts man to trase out what Armes or other figure you please, upon the said board; also let there be another which shall bee an inch and ½ thicke, and of the same breadth, which fasten to the other with some small tackes, till you have boared so many holes as you have occasion for, which shall behalfe an inch asunder, and likewise halfe an inch boare; then boare your holes thorow your inch board, and let them enter an inch into the thicker planke, then make foure square holes (one at each corner) in the thicker planke, to receive foure square pieces of wood, which must be an inch square, which glue fast into foure holes opposite to the other in the thinner planke, to the end it may slide to and fro; then fasten an iron rod in the midst of the thinner, so that it may come thorow the thicker planke, and be fastened to a piece of wood, which may turne upon a joynt; to the end you may draw the thinner square neerer as your fire consumes, and must draw it too foot at least; then provide a small arrow of two foot long, and upon it rowle so much paper, till it fill your small holes exactly, then fill so many as you have holes already provided in your square, and put them thorow the thinner piece, and the ends thereof into the thicker, which let be glued fast into the bottome of that, so that they may stand very fast, and likewise let them passe so easily thorow the other holes, that the board may slide nearer or further, to or from the fire, at pleasure; then fit a piece of past-board, so that it may come close about these rouled lances, and may fit as exactly as the board doth at the other end; and let this come within halfe an inch of the firing end, then prime them all with quicke powder dust, and cover it over with paper, which having performed, you are ready against such time as you have occasion to fire it, which must be after this manner, observing which side the winde is; stand on that side, and fire it at the lower corner, so that by the helpe of the winde, you shall have it all fire at once; which having burnt a while, will come to the past-board and fire it, so that falling away, there will be represented a Coat of Armes in colours, close to your fire, which may be drawne in by one standing behinde, so that it shall seeme alwaies to be standing in one place, and the light not to grow shorter till the last. The forme of this frame is presented in the seventh figure C D.

A *The frame without the scutcheon or letters.*
B *The backe side of the frame, with an iron rod passing therow it, and fastened*

*to the other part, and the moving part which slideth to and fro as occasion proffers.*

D *The frame finished ready to put in your lances.*

F *Represents the face of the frame, or thinner board.*

G *The inner part of the fixed piece, with holes boared in each alike, to put in your lances of rowled paper, filled with slow composition.*

## CHAP. XXIV.

### *How to represent an antike dance, by the helpe of fire, which shall move in a circular forme.*

CAuse a board to bee made of two foot square, so that one side of it may bee hollowed, (or grooved) to lay your rockets in; then cause another board to bee made of the same largenesse, so that it may sit close on the other, the rockets lying betweene, and in the center of the same board, place a brasse socket, which must passe thorow the other for the center pinne to enter into it; then place your antike figures on the top of the said board, with wiers passing thorow both; to the end they may be turned about in their motion, by certaine pinnes placed in another board, which must stand fixed; so that moving about the said board, the pinnes take hold of the wiers which come thorow, and turne them backward and forward; but in regard of the extraordinary violence of this motion, it will teare all in pieces, unlesse you have a great care in making all things to runne very exactly, which must bee tried before you come to use it. The order of this is represented in the seventh Figure by the letter E.

A B C D *The bottome board, which stands fixed with a socket to put on a long pole, and hath a small pinne standing at each corner.*

E E E *The under board which moveth, in which is placed the rockets.*

F F *The uper board which is fastened to the other, wherein the rockets are placed.*

G G *The wiers passing thorow both boards which are fastened to the foot of each anticke.*

H H *The other wiers which stand fast in the fixed board, and are to turne about the antickes passing by them.*

CHAP.

## CHAP. XXV.

### *Another way for making an anticke dance, which is not so violent as the former.*

TAke one of your large sort of wheeles, and fasten it on an iron axeltree, so that the wheele move the axeltree with his motion; then let there bee a screw filed on the said axeltree, which may bee fitted to a small wheele of tenne teeth or thereabouts as you please, for the more teeth there is in the wheele, the slower it goeth, and easier, *et contra*: which wheele let it be so fastened to an axeltree, (on which the board bearing the antickes must stand) that the fire wheele turning about verticall, may move your worke hirozontall, which will move so slow, that the fire wheele will be tenne times about, before your Motion will move once about, which being done neatly, will prove a worke of great contentment. The forme whereof is expressed in the seventh Figure by the letter F.

A *The fire wheele placed on an iron axeltree, and made fast to it.*

B *The screw made on the said axeltree, or filed out of the same stuffe.*

C *The wheele which the aforesaid screw must be fitted to runne with, which must have so many teeth, as you intend the fire wheele shall move about for once of your motion.*

D *The square board on which the antickes stand, and is fastened to the axeltree which hath the wheele.*

E *A place for a light to burne so long as the worke indureth.*

FFF *The detentes or pieces which come therow the board from the foot of each anticke.*

GGG *Certaine pinnes standing upright in the fixed board, to the end that the others passing by may be turned about.*

## CHAP. XXVI.

### *How to compose a Castle of fire worke with the manner of placing the workes in a true order.*

PRepare a Castle of wood, or plate, of what largenesse you please, the which shall bee made foure square, with round towers and battlements, and on the top or inner part of that worke, let there bee a lesser tower of the same fashion, with a Vane on the top, or such a like Figure, which having provided; let there be a place made close to the battlements, or within one inch of them, to lay your conveiances, (which let be of brasse) which is for your reports, which must be placed betweene each battlement, and shall have little pipes of brasse to give fire to each report, which must be screwed into the great conveiance;

ance; which conveiance let be filled with your compoſition for rockets of 1 l, which is one pound of powder to 3i. & of coale duſt; and by this meanes you ſhall have them all fire in order, without any confuſion; which having ſpent it ſelfe, ſhall give fire to another conveiance, which ſhall be placed further in, with a ſtrong wall betweene, ſo that the fire of one doe not offend the other: the uſe of this conveiance is to place divers rockets on, ſo that they may fire one after another, and ſhall take fire as ſoone as the reports are ended. Now for the foure large towers, you ſhal provide foure pieces of wood, turned and fitted to ſlide in exactly, and ſhall have divers ſmooth holes boared round thorow the out ſide of your tower, and the wood, till they meet with the hollow which paſſeth from the top to the bottome, or within an inch, which hollow ſhall bee one inch and a halfe diameter, and muſt be filled with a very ſlow mixture, (to the end it may continue as long as the worke is a burning) then place ſome Fiſgigs round in thoſe little holes, ſo that the mouths may be inward and primed, which will take fire one after another, and flye out on every ſide of your Caſtle, which will give great content: for the manner of firing this, I could wiſh, that it were firſt fired at the foure uper towers, and that through one of the corners, may bee a hole, which may goe to the uper conveyance, that ſo thoſe reports may fire next, and at the end of that conveyance ſhall be another to paſſe downe to the lower tier of reports, and at each corner of that conveyance ſhall be a hole to paſſe into thoſe lower towers, ſo that by that time all the reports are fired, the towers ſhall be all on fire; then at the end of that conveyance, (as I ſaid before) let your conveyance for your rockets bee placed, which taking fire orderly, will conclude the worke. Theſe and the like are for the pleaſure of princes and great perſonages, rather then for the vulgar. The forme of this Caſtle is laid downe in the eight Figure by the letter A.

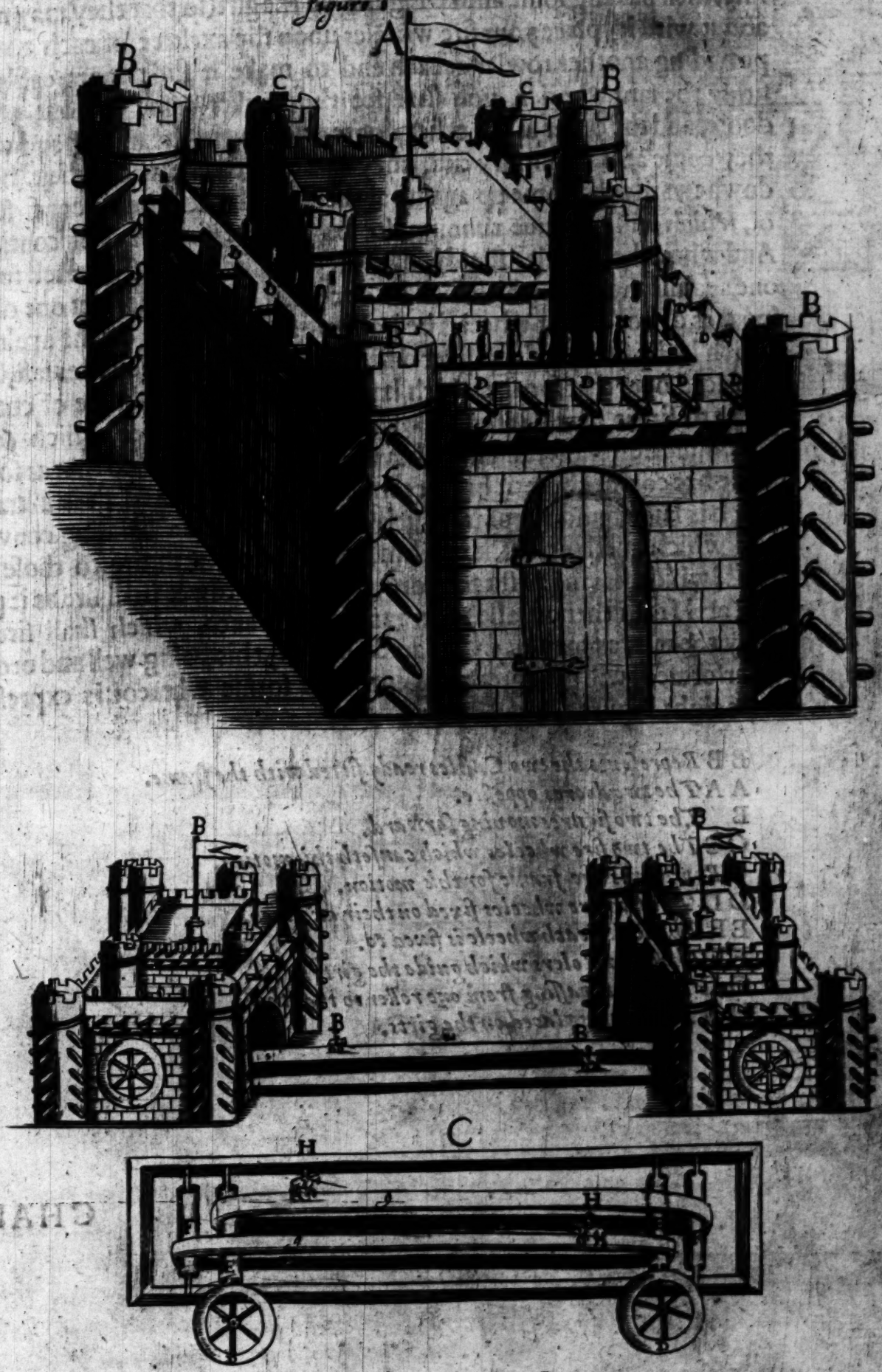
B B B *Expreſſeth the angles of the lower tower.*
C C C *The angles of the higher tower.*
D D *The conveiance that fires the reports.*
E *The conveyance paſſing to the rockets.*
F F F *The Fiſgigs placed round each angle.*
G G *Reports placed on the battlements.*
H H *Rockets placed farther in with a wall betweene.*

## Chap. XXVII.

### *How to repreſent divers motions in a Caſtle of fire-worke.*

CAuſe a frame to be made, placing thereon two Caſtles, that they may ſtand about twelve foot diſtant one from another; this frame muſt bee ſo ordered, that it may bee hollow underneath, which being done, let the dores of thoſe Caſtles bee placed the one oppoſite to the other, at each end of the ſaid frame, and juſt within each doore, let there bee a rowler

*figure 1*



rowler of wood, foure inches diameter, which ſhall have iron pevikts or points to runne upon, that they may runne the more eaſie; and let thoſe roulers be put full of ſmall pinnes, and a girt put round about them, to the end that the rowlers moving circular, may draw the girt in a ſtraight line, then placing ſome antike Figures on the girt (ſo that they may move about with it) place your fire wheeles upon the axeltree of each rowler, providing another rowler at each end to make it ſlide more eaſily; ſo firing the ſaid wheeles, you ſhall ſee the antikes come one out of one doore, and the other at the other doore, meeting in the midſt; and when they come at the contrary end, they make a returne with their heads downeward, and come up againe at the ſame doores they went firſt out of, which will continue running, ſo long as the fire wheeles continue. And when the wheeles ſtand ſtill, the reports ſhall goe off on each tower one againſt another, which ſhall be done after this manner; let one of the ſpoakes of both your wheeles be hollow, and alſo part of the axeltree, which let be filled with powder duſt, and the rocket which fires laſt, ſhall be placed over that ſpoake which hath the vent, with a piece of cotton wicke to fire it, ſo will it runne downe thorow the axeltree, which (as I ſaid) muſt be hollow, and muſt have paper paſted over it, ſo that as ſoone as the fire comes there, it breakes thorow the paper, and fires a traine which is laid round about it, which traine paſſeth to a ſtanding conveyance, which goeth up to the battlements, and ſo giveth fire to thoſe reports; which having paſt each corner, the lower tower ſhall fire as it paſſeth, and from thence paſſe to an inner conueiance, which ſhall fire ſo many rockets, as may be well placed about it; this being well and orderly performed, will give great content. The forme whereof is expreſſed in the eight Figure, N B B.

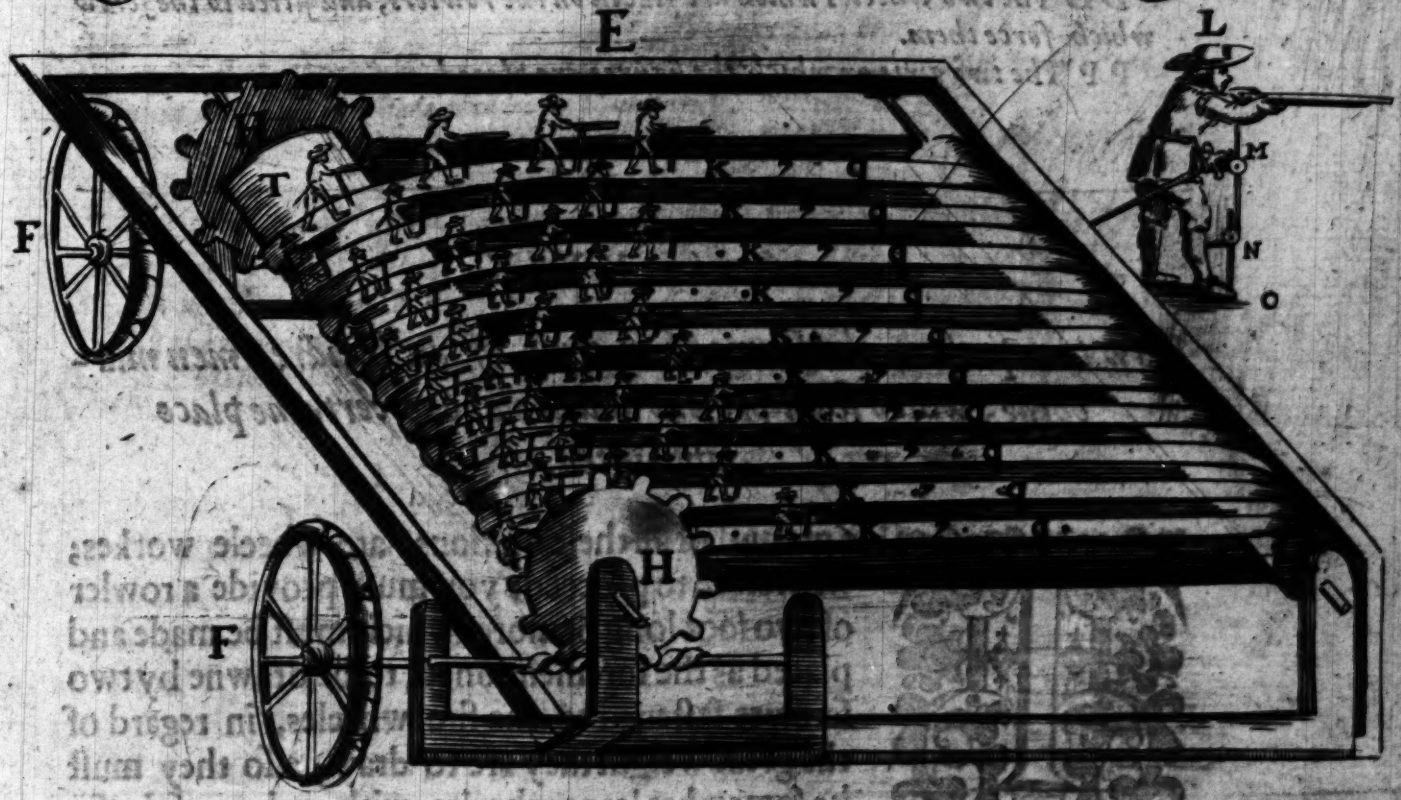
B B *Repreſents the two Caſtles ready fitted with the frame.*
A A *The two doores oppoſite.*
B *The two figures moving forward.*
C C *The two fire wheeles which cauſeth this motion.*
C *Repreſents the frame for this motion.*
D D *The two fire wheeles fixed on their axeltree.*
E E *The Roler each wheele is fixed to.*
F F *The other Rolers which guide the girts.*
G G *The girts paſſing from one roller to the other.*
H H *The figures placed on the girts.*

CHAP.




fig 9th



## CHAP. XXVIII.

### *Another way to performe the ſame motions, and will not be ſo violent as the former.*

PRepare your Caſtle with the frame fitted as the former, onely upon the axeltree of each rowler, let there bee a ſmall wheele with teeth, and likewiſe muſt there bee a ſcrew upon the axeltree of each fire wheele; which muſt be ſo fitted, that they may draw theſe wheeles about, which if they be well fitted, will move them with great facilitie; and whereas the other fire wheeles were placed on each ſide, theſe muſt be placed behinde, or underneath, which you pleaſe, or finde moſt commodious. Now you muſt note that your fire wheele moving once about, moveth but one tooth of your other wheele by reaſon of the ſcrew which drawes him, ſo that if you make tenne teeth in the ſaid wheele, your fire wheele ſhall make tenne revolutions for one of your rowler: by this meanes it will move after a farre more eaſie manner then the former. The manner of this is repreſented in the ninth Figure, A A R.

A A *Repreſents the two Caſtles ready placed.*
R *The frame for the motion.*
B B *Two fire wheeles which forceth the reſt of the worke.*
C C *The ſcrews faſtened on the axeltree of each wheele, which forceth the rowlers.*
D D *The two wheeles which are placed on the rowlers, and fitted to the ſcrew which force them.*
P P *The two girts on which the figures are placed.*

## CHAP. XXIX.

### *How to repreſent the forme of an army of an hundred men marching, which ſhall preſent and fire at one certaine place appointed.*

THe ground of all theſe motions, are wheele workes; wherefore to proceed, you muſt provide a rowler of two foot long or more, which muſt be made and placed as the forementioned, to be drawne by two ſcrewes faſtened to the fire wheeles, in regard of the great weight they are to draw; alſo they muſt be ſomewhat large wheeles, with rockets of the ſecond ſize, which is five ounces in each rocket, placing about each wheele, 20. or more, which having provided, you muſt like-

likewiſe get you ſo many figures of ſouldiers, which muſt bee cut by a Carver, and ought to have the joynts looſe of the right arm of each, with a wyer or detent, to come down from the arm to the thigh of each, and likewiſe another, which may move that, and come to the foot; then place theſe on ſeverall girts, ſo that they may ſtand ten in ranck and file, and may be an inch between each, to the end they touch not at the feet, but every file may run in a ſeverall grooſe; then placing ſmall peeces in their hands, which muſt bee ready loaded and primed, ſet them going, and within two foot of the end of their march, ſet there bee a crooked peece of iron ſtuck up, between each file, ſo that they may ſtand juſt in a ſtraight line, to the end that when the ſouldiers move to that place, the detents or wyers are forced againſt thoſe pins which draw back the arm, and ſo puls the trickers of each Peece in that ranck, ſo that the whole ranck will fire altogether, if they bee well ordered; and as theſe have fired and paſt, another ranck moveth forward to the ſame place, performing the ſame; thus continuing till they have all performed the like, which being finiſhed, and all paſt, they ſhall make a ſecond march, orderly without firing. This being well and carefully ordered, ſhall not faile, and will be a very rare work to behold, but will prove extraordinary coſtly to the owner thereof.

The form of this you ſhall finde in the ninth figure, by the letter R.

*E repreſents the whole frame, with all the parts thereof.*

*F F are the two fire wheeles, being placed one at each end of the rowler.*

*G G the ſcrewes, being faſtned to each fire wheele, which move the two wheeles placed on the rowler.*

*H H the two wheeles being placed at each end of the rowler.*

*I I two rowlers, about which the girts do paſſe, which carry the whole body of men.*

*K K the girts on which the figures are placed, each girt having upon it ten, ſo that in the whole there will be an hundred.*

*L repreſents the figure of a man ſtanding in that poſture as hee ought to bee made.*

*M Is the detent which is faſtened to the right arme, and is to ſlide on a joynt, being faſtened to the thigh; ſo that it may move the arme.*

*N another detent which moveth the former, as it paſſeth by the pin.*

*O the pin which putteth by the ſaid detent as it commeth to it.*

*p p the ſaid pins in their right places.*

CHAP.

## CHAP. XXX.

### *How to present musick playing, (by the help of fire) with anticks dancing.*

CAuse an instrument to bee made, representing the Virginals, and to it fit a Barrell set with severall tunes, (as I shall shew you in another Treatise hereafter) then let there be a wheele with teeth fastned on this barrell, and a fire wheele, with a screw on the axeltree, as I have shewed before, which screw may be so fitted, that as it moves round the barrell one way, so it may move another wheele, being placed on the side, which wheele shall move certain anticks, as the musick playeth. This and many more may bee performed by the motion of wheele work.

The form of this is expressed in the tenth figure, by the letter A:

*B the fire wheele, fixed on the axletree, which moveth a screw.*

*C the screw, moving a wheele placed on the top of it, and another on the side..*

*D the wheele fastned to a barrell set with tunes.*

*E the wheele placed on the side, which hath a pinion at the end of the axeltree, marked F; which carrieth about the wheele G; on which there are placed foure anticks: this wheele moveth foure pinions marked H, on which is placed foure other anticks.*

*I is the barrell set with tunes.*

*K the pallats which causeth the jacks to move.*

*L the jacks which passe up to the strings.*

*M a board or frame covering the strings, on which is placed the anticks.*

Having spoken sufficiently of the order of motions performed by wheele work, I come now to shew some things that may bee done on the Line.

## CHAP. XXXI.

### *How to make a Dragon, or any other creature to run on the Line, by the help of fire.*

LET your Dragon be made either of pasteboard, or else of fine rods, such as your Basketmakers use; which must bee made hollow, with a place in the belly to put in two rockets, and shall bee so ordered, that there may come a small pipe from the tayle of one, to the head of the other; then make a place in the eyes, and mouth, to put into each hole fire, which shall be made up in rowled paper, and thrust in; then on the top of the back let there bee fastned two small pulleys for the line to run in, which being done, your Dragon is finished, to

firing,

firing, which muſt be thus; firſt fire it at the eyes, and mouth, (alwayes noting, that this receipt muſt be ſome ſlow mixture, ſuch as your ſtarres) then fire that rocket which is placed with his mouth toward the tayle of the Dragon, which will make it ſeem to caſt fire from thence, till hee come to the end of his motion; and then on a ſudden, as a creature wounded with ſome accident, ſhall return with fire coming forth of his belly, which being well ordered, will give great content.

The form of this you ſhall finde in the tenth figure, by the letter B.

*B repreſents a dragon to bee forced with rockets, which are placed in the belly.*

*C a place made to put in a rocket, which muſt be put in at the tayle, with the mouth of the rocket outward.*

*D is a conveyance from the tayle of that rocket, to the mouth of the next, which commeth out at the belly.*

*EE two ſmall braſſe pullees, faſtned in a frame on the back, for the line to run in.*

## CHAP. XXXII.

### *Another way for making a fiery Dragon to paſſe on the line without the help of fire.*

IN the former Chapter, I ſpake of a Dragon of a ſmall ſize, of a foot in length, or thereabout; now I come to ſpeak of thoſe of a greater magnitude, which cannot ſo eaſily bee forced with fire, in a ſtraight line, without ſome artificiall help; for Art muſt bee alwayes as a handmaid attending on Nature, to help her in her work; therefore having prepared a large dragon, you muſt make divers hollow truncks of wood, within the body, which ſhall bee to caſt out fire, and on a ſudden divers ſmall bals of fire, other times a great number of ſmall fisgigs. Now to make this run on the line, you muſt have a hollow trunck faſtned on the back, between the wings of your dragon, which muſt bee ſomewhat bigger than your cord, with a ſmall hole thorow each end; the uſe of thoſe ſmall holes is, to faſten a ſmall cord, which muſt be ſo faſtned, that one end thereof muſt bee faſtned at the head of the Dragon, and ſo paſſe over a pulley; (which pulley ſhall bee faſtned at the end of the line) and returning thorow that hollow trunck in the back, it ſhall be put over another pulley at the other end of the line, and ſo making a return, ſhall be faſtned to the hole in the hinder part of the trunck. Now one of theſe pulleys ſhall have a handle or winch to turn it about, which ſhall cauſe the dragon to move, and ſhall be a help to the drawing of it backward and forward at your pleaſure; after this manner you may form many works on the line, which otherwiſe cannot be done. The form of this is ſet down in the eleventh figure, by the letter A.


A
M
G
B
B
E
E

A *representeth the dragon ready finished, with all his works.*

B C *the manner of the hollow trunck which the cord must passe thorow.*

B *the place for fastning of a small cord, which must passe over the pulley, marked* D.

D *the manner of fastning that pulley which must bee at the further end of the line.*

o o o o *the manner of the passing of the sayd line which is thorow the hollow trunck, and so over the pulley marked* E, *and then fastned to the other end of the trunck marked* G.

F *a handle or winch belonging to one of the pulleys which maketh the dragon move forward and backward, as occasion prosereth.*

H H *the great line on which the dragon passeth, and is only for keeping it steaddy in the motion.*

## CHAP. XXXIII.

### *How to represent S. George fighting with a Dragon in fire on a Line.*



Having prepared your figures artificially made, you must make a hollow trunck thorow the body of each figure, for a great line to passe thorow, and likewise for a smaller line to draw them backward from each other; which must be fastned in such manner, at the breast of the dragon, that one end of one cord be tied to it, which shall passe thorow the body of the George, and returning is about a pulley at the other end, fasten it to the back of the George, and at the breast of the George let another cord be tied, which shall passe thorow the body of the dragon, on a prunck on the back, and returning about a pulley at that end shall be pulled straight, and fastned to the tayle of the dragon, so that by your turn that wheele, the George and dragon will runne furiously at each other; and when you please you may [illegible] make a retreat, and come on againe divers times; but shall [illegible] forget not to place your line extraordinary well, and likewise [illegible] that your figures be not too heavy above the line, but that they may [illegible] equallie, for otherwise they will turn their heeles upward, which [illegible] be a great disgrace to the work and workman: there might [illegible] wherein upon this same subiect, but to the ingenious, I think [illegible] and that they may order their works according to their own [illegible] farrels the ground of the matter. The manner of this is re[illegible] eleventh figure, by the letter B.

C *representing the George.*

D *the dragon.*

E *the small line fastned to the head of the dragon, and passeth thorow the body of the George.*

Fig. 22. Fig.



F *the pulley which guideth the ſaid line.*
G *the place of faſtning the other end of that line.*
H *another line faſtned to the breaſt of the horſe, which paſſeth through the hollow trunck of the dragon.*
I *the pulley about which it paſſeth, and is faſtned to the tayle of the dragon.*
K *the place of faſtning the ſaid line to the dragon.*
L L *the great line which guideth theſe two figures.*
M *the winch or handle faſtned to one of the pulleys, and is for the moving them forward or backward.*

## CHAP. XXXIV.

### *How to make a trunck of fire, which ſhall caſt forth divers fire bals.*

PRovide a trunck of foure inch boare, and two foot long, with a hollow place in the bottom, of two inch boare, & as much deep, to the end it may be put on a ſtrong poſt; let there be a bottom left between the two boares, which ſhall be two inches thick, ſo that there will be twenty inches left for your work, which ſhall bee filled as followeth; firſt fill it with corne powder one inch, then put in your ball, which ſhall bee five inches and a halfe, and round about it put powder duſt, till you come to the top, then fill it two inches and a halfe with ſlow mixture, and on that two inches of corn powder: then put in another ball, and after it ſlow mixture, which ſhall be filled to the top, and ſo reſerve it for your uſe; note that you muſt turn three places for arming of it, which muſt be done either with iron hoops or elſe with cords, to the end the violence of your corn powder burſt it not; your upper ball ſhall be made after this manner: Having made ready a caſe of canvas, fill it with this mixture following.

*Take*
℔ *i. of ſalt peter.*
℥ *i. of powder duſt.*
℥ *i. of ſulphur vive.*
℥ *ii. of camphire.*
℥ *i. of oyle of peter.*

Mix theſe very well, till it become ſomewhat tough, and then fill your ball, and arm it, leaving foure vents, into which you ſhall put foure ſmall ſticks, till ſuch time you have coated; the manner of coating is, to dip the ball in a mixture of pich, roſin, tallow, and ſulphur, but this is for bals of longer continuance; the coating for this ball ſhall be as followeth; Take

The receipt for coating,

½ *l. of pitch.*
¼ *l. of verniſh.*
1 ℥ *of ſulphur vive.*
2 ℥ *of powder duſt.*

Melt your pitch and ſulphur, and then poure in your verniſh and powder duſt, and while it is hot dip in your ball, and then caſt a little fine powder duſt over it, and ſo let it coole a little, and then dip it lightly againe, and ſo you have it ready; when you uſe it, pull out your foure ſticks out of the vents, and fill them with powder duſt, and ſo put them in. The lower ball which is laſt fired, ſhall be full of ſtarres, with powder duſt intermixed, to break the ball, theſe ſhall be primed with cotton wick made of purpoſe, to the end it may not fire the bal til it be up a good heighth, and then to break into a ſhowre of ſtarres.

The receipt of the compoſition for the trunck.

1 *l. of roch peter.*
¼ *l. of fine powder duſt.*
½ *of ſulphur vive.*
2 ℥ *of camphir.*
1 ℥ *of linſeed oyle.*

The forme of this trunck is repreſented in the twelfth figure by the letter A:

*A repreſents a trunck ready finiſhed, with two balls.*
*B the ball which lieth uppermoſt, and is filled with ſlow compoſition.*
*C the lower ball, which is filled with ſtarres,*
*D the ſlow mixture at the top of the trunck,*
*E the corn powder to ſend forth the upper ball.*
*F the ſecond lay of compoſition.*
*G the powder for ſending forth the lower ball.*
*ooo three places left for arming the ſaid trunck.*
*H the bottom of the trunck, which muſt be two inches thick,*
*I a place left to put in a poſt of wood for it to ſtand on.*

## Chap. XXXV.

### *The manner of making a Club, which being fired, ſhall caſt forth divers ſmall works, or fisgigs.*

CAuſe a peece of wood to be turned of foure inches diameter, boare it one inch and a halfe from the top toward the bottom, only leaving a bottom of an inch thick, and likewiſe a place underneath to put in your club ſtaffe, the length of this trunck may be eighteen inches; then draw a circular or ſpiral line, from the top to the bottom, which let bee in the manner of a ſcrew, every thred being an inch and a halfe aſunder, and in that line boare ſmall holes, (of the bigneſſe of one of your fisgigs) till you come within a quarter of an inch of the bottom

tom of each hole; and then pierce it with a ſmall piercer, till you come to the ſoule of the trunck. Having done this, make ſmall wyers fit to each hole, which let be faſtned, ſo that they may ſtand oppoſite to the ſaid holes, within two inches off from each hole; the uſe of them is, to keep your fisgigs more upright and ſteaddy, which otherwiſe would bee apt to fall out, by reaſon they muſt bee put in very ſlack, or elſe they would not ſo eaſily come forth, when they ſhould, then load your trunck with the ſlow mixture appointed in the former chapter (for a trunck) and put in your fisgigs, priming each, and likewiſe each hole, and ſo firing it at the top, you ſhall finde them come forth one after another, as your trunck burneth downwards, which ſhall ſcatter abroad after a confuſed manner. The form of this you ſhall ſee in the twelfth figure, by the letters EI.

*E repreſents the form of the club without the wyers on, or any other work.*
*I is the ſaid club ready finiſhed with all his work.*
*K the wyers placed for to ſtay each fisgig in his place.*
*L the fisgigs placed.*
*M the place of firing.*
*N the club faſt put into the bottom.*

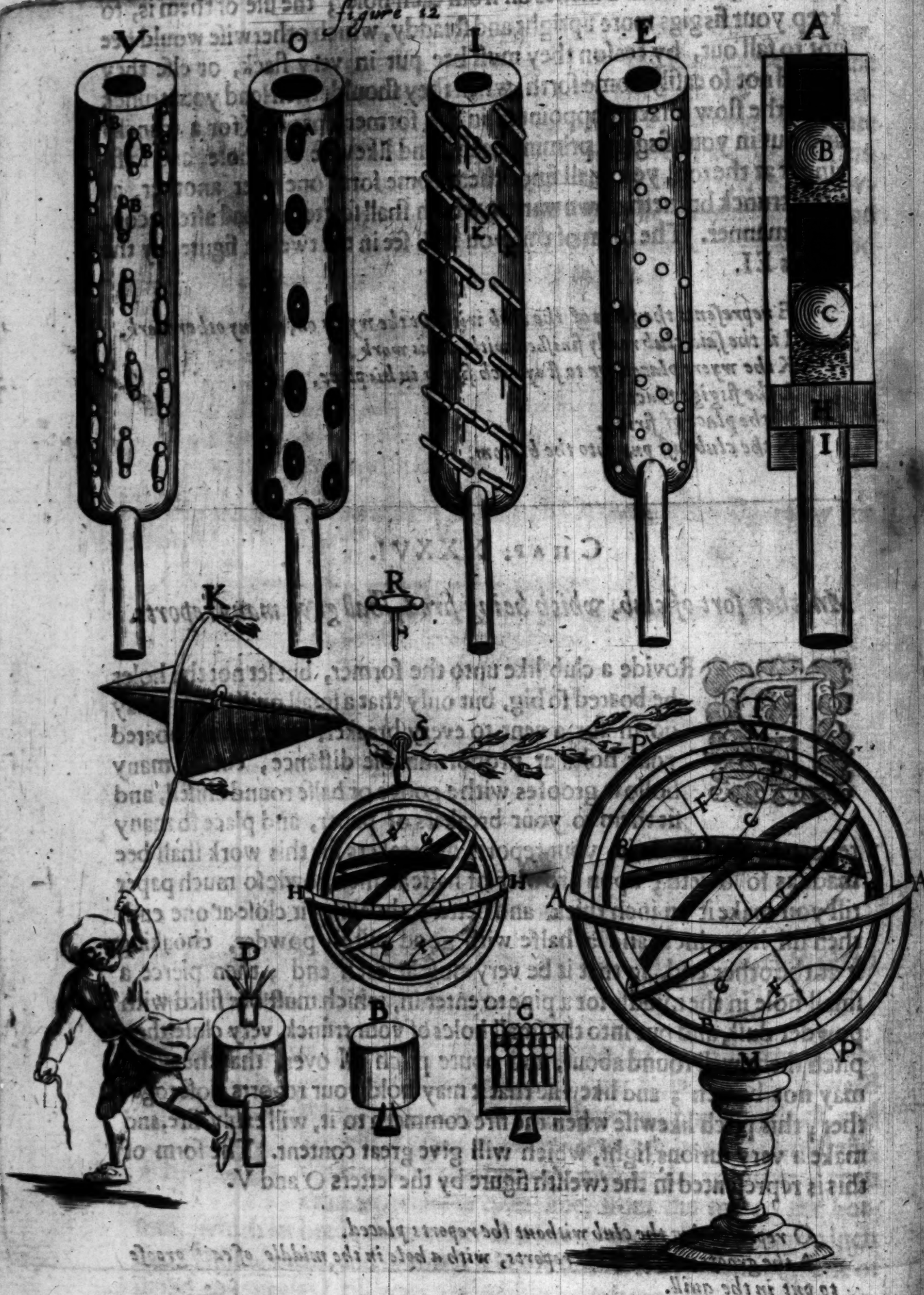
## CHAP. XXXVI.

### *Another ſort of club, which being fired, ſhall give many reports.*

PRovide a club like unto the former, but let not the holes be boared ſo big, but only that a ſmall quill or pipe may go in for a vent to every breaker, then having boared your holes at proportionable diſtance, cut ſo many hollow grooſes with a googe or halfe round chiſell, and fit them to your breakers of paper, and place ſo many reports round about it; your reports or breakers for this work ſhall bee made as followeth; upon a rowler of halfe an inch, rowle ſo much paper till you make it an inch thick, and better, choaking it cloſe at one end, then fill it an inch and a halfe with good piſtoll powder, choaking it at the other end, ſo that it be very cloſe at each end; then pierce a ſmall hole in the middle for a pipe to enter in, which muſt bee filled with powder duſt, and put into the ſmall holes of your trunck, very cloſe, then pitch them well round about, and poure pitch all over, that the work may not be ſeen; and likewiſe that it may hold your reports cloſe together; this pitch likewiſe when the fire commeth to it, will eaſily fire, and make a very furious light, which will give great content. The form of this is repreſented in the twelfth figure by the letters O and V.

O *repreſenting the club without the reports placed.*
A *the grooſes to put in the reports, with a hole in the middle of each grooſe to put in the quill.*
R *a report with a quill ready to be placed in the club.*

figure 12



q *the manner of the quill which must bee put into those small holes to fire the reports.*
V *the club finished, with the reports placed in it.*
B B *the manner of the reports as they are placed in the said club.*

## CHAP. XXXVII.

### *Another, which I call Jack in a box.*

THE order of making this is after this manner; provide a box of plate, of what largenesse you please, which let be six inches deep, with a socket at the bottom to put in your staffe, then putting in a quantity of corn powder or powder dust, (in the bottom of the box) you shall fill it with fisgigs, or serpents, leaving a place in the middle for a cane to go thorow to the bottom, which cane must be filled with slow receipt, in which you shall put a quantity of camphir, but no oyles, in regard of the narrow passage it hath to burn, without any other vent; then put your cane down, leaving it an inch above the box, and take a peece of thick pastebord, cutting a hole for the cane to passe thorow, and glew it close to the cane, to the end the fire passe not thorow before the appointed time; this pastebord must bee of sufficient breadth to cover your box quite over, then put it on a staffe, and light your cane, which will appeare only like a candle, and after a pretty distance of time you shall heare a sudden noyse, and see all those fisgigs flying some one way, some another. This toy hath given great content to the spectators. The form of this is set down in the twelfth figure by the letters B C D.

B *the box without any thing in it.*
C *the fisgigs placed in the box.*
D *the box finished, with a cane passing thorow to the bottom.*

## CHAP. XXXVIII.

### *How to represent the Sphere, moving in the ayre, without any other supportation.*

CAuse a Sphere to bee made somewhat light, and on the horizon place your rockets, and in the zenith or upper part, let there bee a pinne passe thorow the meridian, with a ring fastned to it, to hang it by; this must bee fastned to a large Kite, so as the Sphere may hang six foot under it, then fasten a match of cotton to the nose of the first rocket, and light it, which having done, raise your Kite, and by

by ſuch time as it is at the higheſt, the rockets ſhall take fire, and ſhall cauſe it to make divers revolutions in the ayre; you may place the midſt of this ſphere full of lights, which will ſeeme very ſtrange. The manner of this is repreſented in the twelfth Figure, by the letters K and S.

K *Repreſents the Kite which is ſupported by the ayre, and to which the ſphere is faſtened.*
S *The ſphere with all his circles, the rockets being placed about the horizon.*
H H *The horizontall circle about which the rockets are placed.*

## Chap. XXXIX.

### *How to repreſent the ſphere, with divers circles, ſome moveable, others fixed.*

CAuſe a ſpheare to be made, either of wood or mettall, the outward circles repreſenting the meridian circle with the horizon, the next within ſhall repreſent the Collurs with the equinoctiall, likewiſe the tropicks and zodiacke, whoſe poles ſhall be 23 degrees ½ from the poles of the world; by which meanes the ecliptick ſhall bee excentricke to the equinoctiall, (which ſhall be expreſſed) ſo that faſtening rockets about the equinoctials, and placing two ſmall lights in the zodiacke, the one repreſenting the Sunne, the other the Moone: you ſhall ſee them move about the earth, (which is placed in the midſt of the ſpheres) according to the rules of *Tycho Brahe*, and ſhall be according to their naturall manner of motion, which is continually riſing and ſetling in an oblique motion to the horizon and meridian, which alwaies ſtand fixed, and the reſt moving on the poles of the equinoctiall, although the ecliptick bee framed from its owne poales. The forme of this is repreſented in the twelfth Figure, by the letter T.

M *The fixed Meridian.*
A A *The Horizon.*
E E *The Equinoctiall.*
E E *The Ecliptick with the Sunne and Moone placed round.*
P P *The poles or axeltree about which all the inner circles move.*

## CHAP. XL.

### *How to make a halfe moone of Rockets to appeare in the ayre.*

PRovide a piece of planke of two inch thicke, and turne it to a halfe round, then cut so many groves (from the center to the circumference) as you intend to place rockets about it, and on the other side, let there be rings for every rod to passe thorow, of which let one of each bee close to the top, and another neere the end of each rod; and note that the planke must be so large, that the ends of all the rods must meet in the center; then prime each rocket with a quill filled with powder dust, and put on the top of each groose, till you have placed your semicircle full; then having primed these grooses, (which comes from one center to the circumference) paste paper over them, and so let it stand till you fire it, which is done after this manner: set this same at the top of a poast, about foure or five foot from the ground, and prime it (at the center) with a little cotton wicke prepared for that purpose, and firing it, you shall see them take fire all at one instant, and so will flye circular, in the forme of a halfe Moone. The forme whereof is represented in the thirteenth Figure, by the letters A B.

A *Represents the forepart of the frame, in which one presents the grooses which passe to each rocket.*

D D *The quils filled with powder dust, entring into the grooses with one end, and into the rocket with the other.*

B *Represents the backe part of the frame.*

E E *The rings below.*

F F *The rings above.*

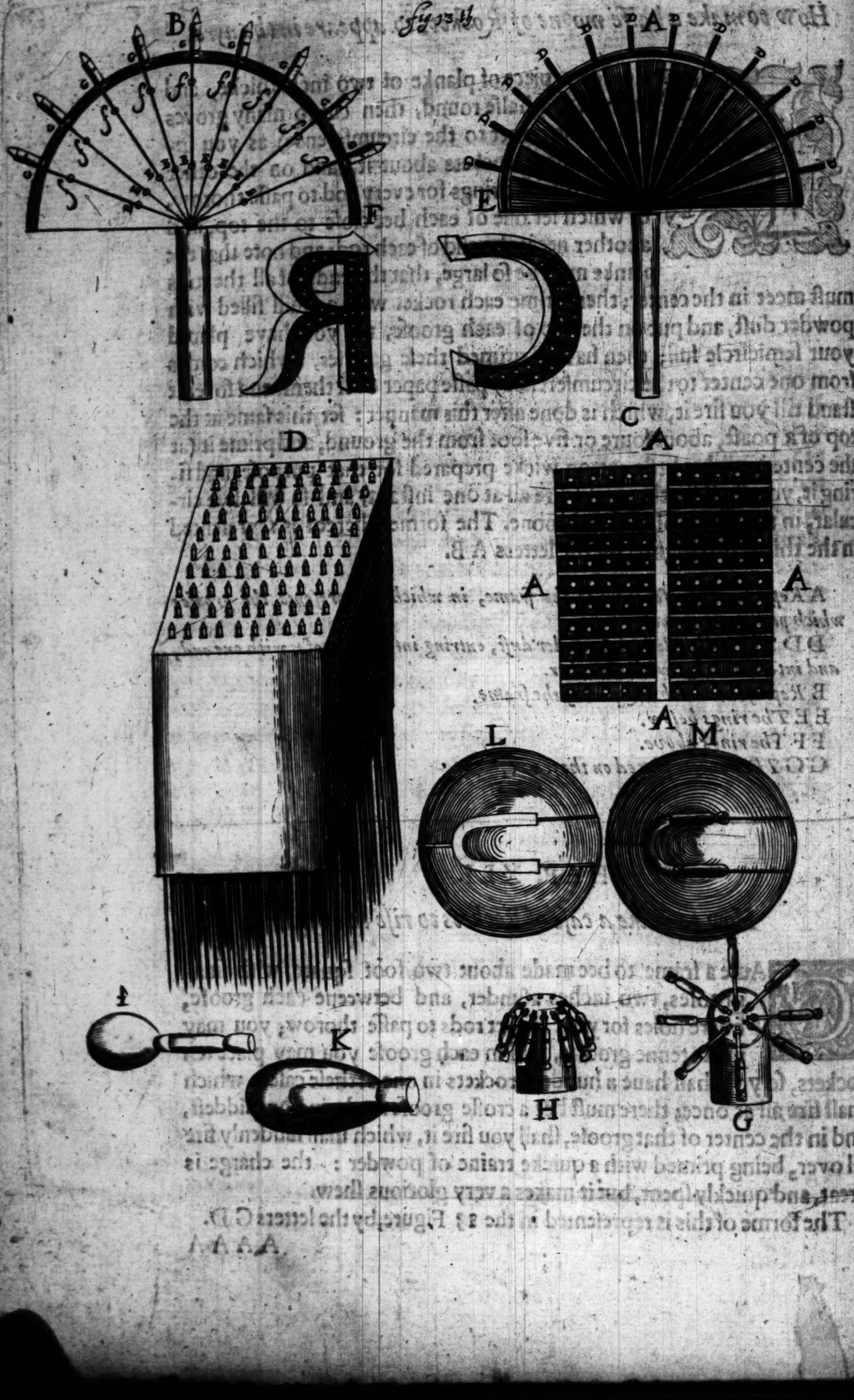
G G *The rockets placed on the frame.*

## CHAP. XLI.

### *How to make a case of Rockets to rise at once.*

CAuse a frame to bee made about two foot square, with small grooses, two inches asunder, and betweene each groose, boare holes for your rocket rods to passe thorow, you may make tenne grooses, and in each groose you may place ten rockets, so you shall haue a hundred rockets in one of these cases, which shall fire all at once; there must bee a crosse groose made in the middest, and in the center of that groose, shall you fire it, which shall suddenly fire all over, being primed with a quicke traine of powder: the charge is great, and quickly spent, but it makes a very glorious shew.

The forme of this is represented in the 13 Figure, by the letters G D.


B
A
F
E
C
D
A
A
A
L
M
K
H
G

A A A A *Represents the ſquare of your caſe which is grooved.*

*The white ſtraakes ſignifie the grooſes which are to be filled with powder duſt, whereon the mouth of your rockets muſt be placed.*

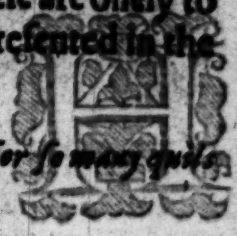
*The other ſpaces expreſſe the holes where your rods paſſe therow with a hole in the midſt to fire it at.*

B *Repreſents the caſe filled with rockets, their rods paſſing therow, and is made long, to the end there may be another board at the bottome for each rod to paſſe thorow, that they may be kept more ſteady.*

## CHAP. XLII.

### *How to make letters, or any other figure appeare in the ayre, after the ſpending of a Rocket.*

HAving conſidered of what largeneſſe you will haye your letters or figures, make them of paſtboard, leaving a hollow to put in ſmall quils, (which ſhall bee filled with a cleare and ſtrong mixture) then put in your quils, and glue them faſt in, and and ſo have you finiſhed it, till you come to uſe it. There is another manner, which is thus; provide a mould of plate, and cut out what letter you pleaſe in waxe, which having done, flicke it full of quils in an orderly forme, and put this on the head of your rocket: note this, that theſe are onely to be uſed on very large rockets. The forme of theſe are repreſented in the thirteenth Figure E F.



*The forme of the letters, the white ſpots ſignifying the place for ſo many quils filled full of ſlow mixture, to be placed in.*

## CHAP. XLIII.

### *How to repreſent a figure of the Sunne caſting forth his beames, in fire.*

CAuſe a boxe to be made of plate, too inches long, and one inch diameter, which muſt be filled with your ſlow compoſition, and let the head be made with ſmall grooſes, croſſing the center, to the end you may lay in certaine ſprings of ſteele, ſuch as they uſe to ſmall Watches. Theſe ſprings ſhall bee about ſixe inches in length, and muſt be foure, ſo that both ends of each appearing, will make eight, which will make a circular forme, the boxe being the center; now to the end of every one of theſe ſprings, muſt be faſtened one of your ſmall Fiſgigs, & then bent up cloſe to the boxe, and ſo put into your coffine at the

top of your rocket, with powder duſt and cotton to fire and breake the coffine, which as ſoone as it breakes, the ſprings will caſt forth your Fiſgigs, and make them ſeeme like the ſparkling beames of the ſunne, and the mixture in the center will ſeeme as the body of the ſame; this will continue a while, and then you ſhall ſee it breake with divers reports. This I had from a noble Captaine of this City, namely Captaine *Foreſtar*, who invented the ſame, the forme whereof is repreſented in the thirteenth Figure, by the letters L M.

L *Being the boxe with the ſprings faſtened to the top, with a Fiſgig at the end of each.*

M *The ſaid boxe finiſhed with the ſprings bent ready to put on the head of a Rocket; the mouth of each Fiſgig muſt come downe to the mouth of the boxe, and ſo be put with their mouthes all downewards.*

Having ſpoken ſufficiently of workes operating in the ayre, I will ſhew you ſomething which ſhall ſerve for ground workes.

## CHAP. XLIV.

### *How to make a Rocket which firing it out of your hand, ſhall continually be in agitation on the ground ſometimes, and other whiles about in the ayre.*

HAving prepared a Rocket, with a report in the head, tye it to a bladder, ſo that the end of the Rocket may come to the mouth of the bladder, and binde it over very ſtrongly, then firing it out of your hand, caſt it away from you, it matters not which way, for it will come to the ground, and by reaſon of the bladder, it cannot ſtay, but preſently rebounds upward, moviug to and fro, till it be all ſpent. There is another ſort, and that is a ſmall Rocket put into a bladder, and ſo blowne up round about it, and tyed about the necke of the Rocket. The forme of theſe are repreſented in the 13 Figure, by the letters G H.

G *The Rocket with the bladder at the taile of it.*
H *The Rocket in the bladder.*

CHAP.

## CHAP: XLV.

### *How to make a ball which ſhall be in continuall agitation on the ground, till the fire is conſumed.*

CAuſe a ball to be made of ſome light wood, which muſt be made ſo, as you may take it aſunder juſt in the midſt, then make on each ſide a hollow groofe to lay in two rockets (joyned together after the manner of your runners) ſo cloſe up your ball faſt with glue; onely in the place where the two Rockets joyne, ſhall be a groofe, which ſhall be paſted over with paper, that the ſecond rocket firing, may have a vent, otherwiſe your ball will ſerve but once. Then fire it, and you ſhall have your deſire. This is repreſented in the 13 Figure by the letters I K.

*I Repreſents a part of the ball, as it is ready to place in the Rockets.*

*K Repreſents the ball, with the Rockets placed in, ſo that the other ſide being joyned, makes a perfect round.*

*CCC The vents to each Rocket, which being cloſed, muſt have paper glued over them, that they be not ſeene.*

## CHAP. XLVI.

### *How to make another ſort of Balles for the ground, which will be a long time in their motion.*

CAuſe a ball to be made of ſome light wood, and let it bee hollowed, to make it the lighter; then fit in two pieces of wood, ſo that you may make both ſides equall, which pieces of wood ſhall be ſo grooved, that you may lay in ſo many Rockets as may well be contained about it, providing that at the end of each groofe or rocket, you may have a vent thorow your ball, then place in your rockets as I have ſhewed you for the wheele: which having done, glue them faſt in, to the end, that by the motion of the ball, they may not be diſordered, then ioyne your ball together, and glue it faſt with paper round about it, to the end the vents may be covered, onely leaving one open to fire it, ſo have you this ball finiſhed, which firing, will continue a long while in motion, Figure 36.

*A The ball turned hollow with groofes to lay in your rockets.*
*B The other part of the ball, with the rockets faſtened in.*
*CCCC The vents at the end of each rocket.*

## CHAP. XLVII.

### *How to make a Dragon issuing forth of a Cave, which shall cast out much fire.*

PRovide a Dragon of some light matter, as wicker rods or the like, which let bee made so, that you may put into the midst of the body, one of your greatest rockets, and close under the belly let there be a couple of wheeles, which shall bee so placed in the belly of the Dragon, that no part may bee seene, but onely the bottome which comes to the ground; and let the rocket bee so placed, that it may with traines fire all parts of the body, as the eyes, mouth, and all other parts; in which you shall place divers small workes, which firing, shall flye out, and make a very great shew, which shall burne till all bee consumed: this Dragon must be so placed, that he may come forth of a seeming cave; which firing on a sudden, will make a great noyse, by reason of the largenesse of the rocket, and the hollownesse of the cave hee comes forth of. The forme whereof is represented in the fourteenth Figure by the letter G.

G *The Dragon ready finished.*
A *The wheeles on which it must runne, which must bee hid within the body.*
B *The rocket placed in the body of the Dragon, which causeth the motion.*
G *The vent which passeth to this rocket for the firing.*

## CHAP. XLVIII.

### *How to make two Dragons to meete each other, from severall Caves, which shall send forth their fire to each other with great violence.*

HAving prepared two Dragons (both of one size and weight) after the manner as I have shewed you in the former Chapter; it is requisite that you know how farre they will runne, then place the Caves at such a distance one from the other, that they may meete each other in the mid way, and that you may doe this the more neater, you shall have your ground laid with smooth boards that they may runne more free, and from the midst of the walke, to the end of each Dragon; let there be a groose made in one of the boards, which shall serve to convey a traine to each, for the firing of them; then you shall be sure, that if you fire it in the midst, they will both take fire together; alwaies provided you make a conveyance of paper from the board to the taile of each Dragon, or to the mouth of each rocket, which being fired once, they

shall

ſhall meete, and caſt forth their fire at each other with great violence. The forme of this is repreſented in the fourteenth Figure, by the letters A A.

A A *The two Dragons ready to runne.*
B B *The two great rockets which forceth them.*
C C *The wheeles which each Dragon runneth on.*
D *The midſt of their walke, with the grooſe to each rocket.*

There are divers other workes which may bee performed after this manner, which for brevity ſake I will omit.

Likewiſe there are divers motions to bee performed by the action of man, as ſingle duels, to which appertaine the Buckler of fire, and likewiſe the Curtlax or Fauchion, the manner of which hath beene formerly deſcribed by divers Authors, almoſt in all languages, and therefore will ſeeme more then requiſite to relate thoſe things ſo large as they might be; for what action cannot man performe by his induſtry? and therefore I leave every man to his owne order, onely I will ſhew you the making of one ſort of Bucklar, which as yet hath not beene performed, and likewiſe the Fauchion or Curtlax, and firſt for the Bucklar.

## CHAP. XLIX.

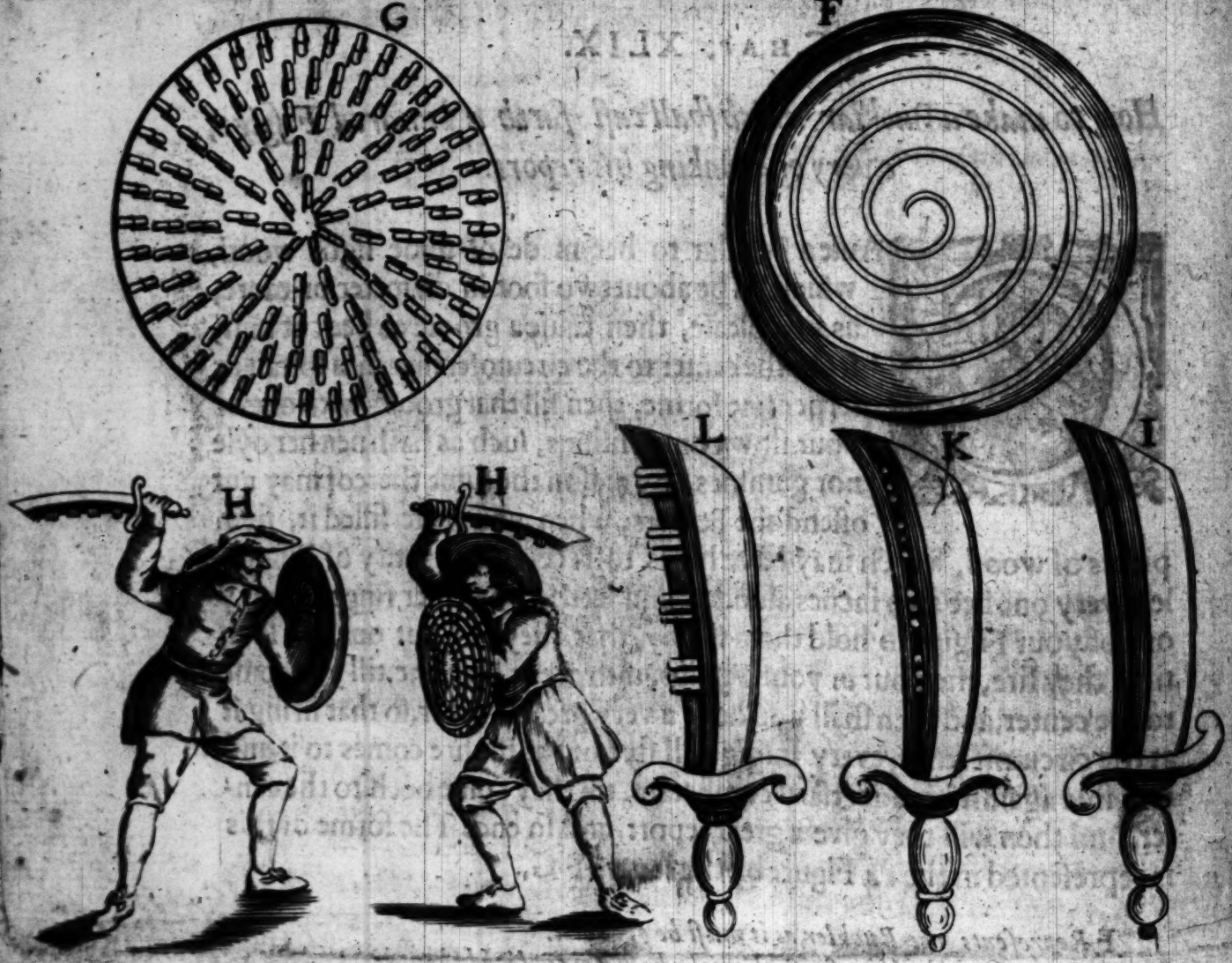
### *How to make a Bucklar which ſhall caſt forth a hundred Fiſgigs, every one making his report.*

CAuſe a Bucklar to bee made of ſome light wood, which let be about two foot in diameter or more, as you pleaſe, then cauſe a grooſe to bee cut in it, from the center to the circumference in a ſpirall or ſerpentine forme, then fill that grooſe with one of your ſlow compoſitions, ſuch as hath neither oyle nor gummes, by reaſon the ſume thereof may not offend the Bearers; when you have filled it, fit in pieces of wood, which may have holes to receive a quantity of Fiſgigs, let every one bee two inches aſunder, and let there be wyer rings to every one of your Fiſgigs to hold them ſteady, that they fall not out, till ſuch time they fire, then put in your Fiſgigs, into every hole one, till you come to the center, and then ſhall you have a very great breaker, ſo that firing it at the circumference, every Fiſgig will flye out as the fire comes to it, and will flye againſt his adverſary combatant, till they come both to the center, and then will they give a great report, and ſo end. The forme of this is repreſented in the 14 Figure by the letters F G.

F *Repreſents the Buckler as it muſt be grooved.*
G *Repreſents the ſame finiſhed, with the Fiſgigs placed about it.*
H H *Repreſents the manner of uſing the ſaid Buckler, with the Fauchion.*

Fig 34



## CHAP. L.

### *How to make the Curtlax, Cimiter, or Fauchion.*

PRepare a Curtlax either of wood, or plate, which let bee hollowed from back to edge, three inches, and let it bee so thick, as it may serve for your smallest fisgigs, then you shall have a peece of pastebord so fited on the back, that your work may be close covered, only holes left for the ends of your fisgigs to come furth; then you shall lay in your lances of fire (which is nothing else but your slow composition for starres put into hollow truncks of paper made on an arrow) and between every lance you shall put two or three fisgigs, which shall fly out so soon as the fire commeth to them; having done this, you have finished your Fauchion, which must bee fired at the point, and so burn downward towards the hilt. This hath been formerly set forth by Monsieur *Thybaviel* a French Author, and since by divers others. The forme whereof is represented in the fourteenth figure, by the letters I K L.

I *represents the Fauchion prepared, with a groose in the back.*
K *represents the Fauchion, with holes to put in the works.*
L *represents a Fauchion wholly finished, with the fisgigs placed as they ought to stand.*

Having spoken sufficiently of land works, I will come in the next place to shew the making of some works to bee acted on the water; and first of all I will shew you the making of the water balls.

## CHAP. LI.

### *How to make a water ball, which shall burn on the water, with great violence.*



Irst, having considered of what bigneſse you will have your ball, take the circumference and halfe it, and of that halfe make a circle, which cuting out in strong canves, shall bee halfe a case, so that sewing two of them together, they shall make a case according to your desire; *For Example*; I have a ball to make whose diameter is six inches, then the circumference (being as seven to twenty two) must be 18 $\frac{6}{7}$, so the halfe will bee 9 $\frac{3}{7}$, which must bee the diameter of your cloth, and must bee made true round, so that sewing two together, and making a case thereof, it shall bee almost six inches, which the arming will make good; having made your case, you shall proceed to the filling of it, which shall be done after this manner; you shall first put in three or foure good spoonfuls

ſpoonfuls of your mixture, and then with a ſtick (made round at one end) force it cloſe together, and ſo continue filling it, and between every filling put in your ſtick, and force it together, rounding it continually in your hand, till ſuch time you have finiſhed it; which having done, ſew it up cloſe, and then arm it with ſmall cord, which is called marling; after you have done that, you ſhall coat it with a quantity of roſin, pitch, and tallow diſſolved, and ſo your ball dipped over in the ſame, providing alwayes that you leave two vents to fire it, which ſhall be pierced a third part into your ball, and muſt bee ſtopped with ſmall ſticks, till ſuch time you come to uſe them, then pulling forth the ſticks, fill the two vents with fine powder duſt, and firing it, caſt it into the water, and you ſhall have your deſire; you muſt alwayes let your ball be thorow fired before you caſt it from you.

A receipt for this ball.

*Take* 1 *l. of powder.*
8 *of rochpeter.*
4 *of ſulphur.*
2 *of camphir.*
1 *of oyle of peter.*
1 *of oyl of linne.*
½ *of oyle of ſpike.*
2 *of colophonia.*

The forme of this ball is repreſented in the fifteenth figure by the letters A B.

A A *the canvas ready cut, to be ſewed together.*
B *the ball finiſhed.*
C C *the two vents.*
D *a peece of cord left to hold it by whilſt you coat it, and likewiſe to hang it up being finiſhed.*

## CHAP. LII.

### *A water ball which ſhall ſhoot forth many reports.*

CAuſe a ball to be made of wood, which ſhall bee in two peeces, ſo that you may joyne it cloſe together at pleaſure; this ball muſt have ſmall holes boared round about it, to put in your quils, which muſt fire your reports; the reports or breakers ſhall bee made of paper choaked at both ends, and primed thorow the midſt; they ſhall bee faſtned round with pitch, and ſo covered round about, that no water may paſſe in; you ſhal fil this bal in two halfes, to the end you may force it very cloſe together, and when it is filled, glew it faſt, and arm it well with nealed wyer, then put in your breakers, with a quill

which

which shal enter into the bal, and likewise into the breaker; the forme whereof you shall see in the fifteenth figure, by the letter C. The receipt for this bal must be somewhat slower than the last, by reason of the many vents it wil have, as the reports passe away.

The receipt for this ball.

*Take* 1 *l. of rochpeter.*
4 ℥ *of powder dust.*
3 ℥ *of sulphur vive.*
2 ℥ *of camphir.*
1 ℥ *of linseed oyle.*
2 ℥ *of rosen.*
1 ℥ *of oyle benedick.*

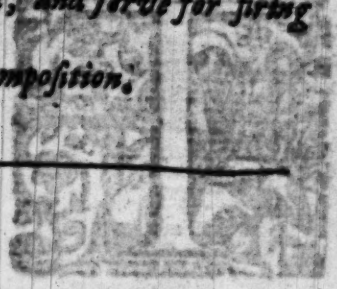
Powder that which is to bee powdered, and incorporate them well together, and by little and little sprinckle your oyles, til you have wrought it like a paste, and then make use of it; your quils which you prime with shal be filled only with powder dust, to the end it fire suddenly before the quil come to shrink up, which wil be with a slow mixture.

A *the mouth of the ball where it is to be fired.*

B B B *the reports or breakers, being made of paper, and filled with corne powder.*

C C C *the quils, which are primed with powder dust, and serve for firing the reports.*

D *the hollow of the ball, being filled with the slow composition.*



## CHAP. LIII.

### *How to make a Water ball, which, after a certaine time of firing, shall cast forth divers rockets into the ayre.*

PRepare a ball of wood, of eight inches diameter, and boare a hole in the midst (of an inch and a halfe) and let it come within one inch of the bottom, and round about that great hole you shall boare eight smaller holes of an inch, so that they may bee fit for eight rockets; these holes shall be an inch from the greater, and shall all meet in one at the bottom; wherefore you shall cut off the bottom of the ball, and fit another to it, which may be so hollowed, that your mixture may be conveyed to all the rockets, then fasten on the bottom (having filled it with your mixture) and put in your rockets, with the mouth of each rocket downward, pasting paper round about it, which shall bee coated with rosin and tallow, and over each hole where the rockets are placed, let it be soaped over the tallow, to the end that being fired, the sparks may not easily take fire of the paper, which otherwise would make some confusion; having done this, fit in a peece of wood to the greater boare of your ball, leaving only a smaller vent, of halfe an inch, and by this

meanes

meanes the fire will come out with more violence, and having ſpent it ſelfe, within one inch of the bottom, it ſhall fire the eight rockets placed about, which by their force ſhall break the paper of each, and aſcend into the ayre, a ſmall heighth, and after lie tumbling on the water. This ball is repreſented in the twelfth figure by the letter D.

A *the place of firing the ball.*
B B *the peece of wood put in to leſſen the vent.*
C *the greater hollow to be filled with the ſlow compoſition as the former.*
D D *the bottom, which is looſe, and to bee hollowed to receive part of the ſlow mixture.*
E E *the holes boared to put in the rockets, which muſt bee covered with paper.*
F F *the rockets placed in, with their mouthes downward.*
G G *the place of fitting the rockets.*

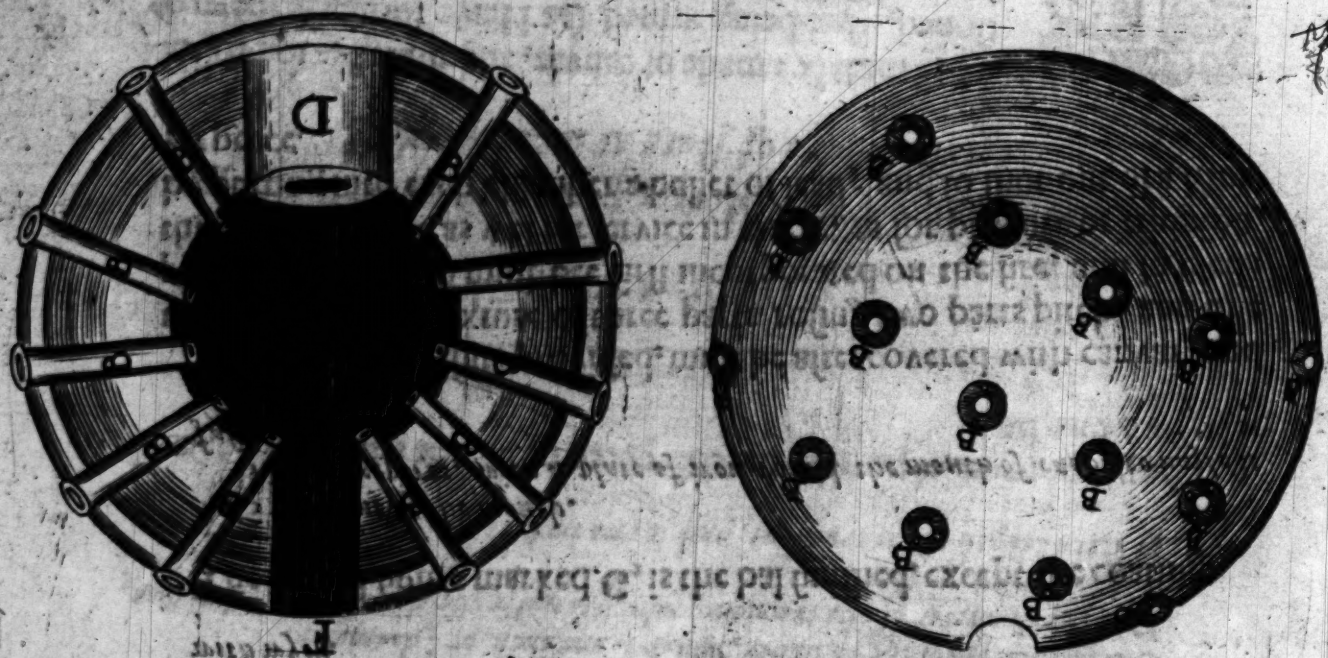
## CHAP. LIV.

### *Another ſort of water ball, which ſhall caſt forth rockets at two ſundry times, and after it is finiſhed, ſhall give a great report.*

THis ball ſhall be made after the manner of the other, but ſhall bee a foot in diameter, and ſhall have two circles of rockets placed round about, ſo that the lower circle ſhall be one inch from the higher, and likewiſe ſhall go down into the ball an inch lower, and under that row of rockets there ſhall be placed a breaker of iron, which ſhall bee one inch from the lower tyer, ſo that the ball being fired, ſhall after a certain time, caſt forth a dozen of ſmall rockets, and then continue a while longer, and then in regard of the larger circumference of that circle, it ſhall caſt forth twenty, and after that is ended, their fire comming to the chamber of iron, ſhall cauſe a very great report, and ſo conclude. The form of this is layd down in the fifteenth figure by the letter H.

H *the vent for firing the ball.*
I I *the peece of wood fitted to the greater boare.*
K *the hollow of the greater boare filled with a ſlow compoſition.*
L L *the upper tyer of rockets.*
M M *the lower tyer of rockets.*
N *the breaker of iron.*
o o o o *the places to put in the rockets, which muſt bee covered with paper well ſoaped, upon tallow.*

CHAP.


D
G
D
D
F
F
E
E
B
B
A
A
M
M
L
L
I
I
H
E
B
B
C
A
A

## Chap. LV.

### *Another ſort of ball, with iron chambers, every one caſting forth a ſmall ball.*

CAuſe a ball to be made, of twelve inches diameter, and in the midſt boare a large hole of two inches high, hollowing it within, and let it come within an inch of the bottom; then boare ſmall holes of an inch from the top to the bottom, in a ſpiral line, to put in your ſmal chambers, which ſhall be made of iron, each chamber having a broad plate at the mouth to faſten it to the ball; thoſe chambers ſhal be loaden with a quantity of corn powder, and after that a ſmal ball made up in canvas, and primed, as I have ſhewed you for ſtarres, then having filled the large concave with ſlow compoſition, place in your chambers, whoſe touch holes or vents muſt bee juſt at the breech, and ſhal come al in toward the center of the ball, then coat it round with roſin and tallow, and ſo have you this bal finiſhed; the form whereof is repreſented in the fifteenth figure, by the letter A.

The firſt figure marked F, repreſents the inſide of the bal.

F *the mouth of it.*

BB *the iron chambers, as they lie with the touch hole or vent of each chamber, at the breech of the ſame.*

C *the concave filled with ſlow compoſition.*

D *a large chamber placed at the bottom: note, that this ball muſt bee made in two peeces, to place in this chamber, and after glewed well, and bound about with wyer.*

The ſecond figure marked G, is the bal finiſhed, except the coating.

G *the vent at the mouth.*

BB *the reports, with a plate of iron round the mouth of each, to nayle it faſt.*

This bal being thus provided, muſt be after covered with canvas, and then dipped in a mixture of three parts roſin, two parts pitch, and one part tallow, which muſt bee firſt incorporated on the fire, and ſo uſed: this bal may ſerve as wel for ſervice in warre, as for pleaſure or triumph, by putting into each chamber a bullet of lead, and ſo ſhot out of a Morter peece.

CHAP.

## Chap. LVI.

### *There are divers other ſorts of bals, as well for water as for land, and are to be ſhot out of the Morter peece.*

AND becauſe the Morter peece is often uſed in Fire-works, I will deſcribe the manner of it, with the uſe thereof, as much as is requiſite to this place: and firſt for the manner; the manner of the Morter peece conſiſteth only in his proportions, which are divers, according to the pleaſure of the workman; but thoſe of moſt uſe for fire bals, are one and a halfe, and two diameters, in the length of the chaſe, and one diameter in the length of the chamber, with halfe a diameter at the mouth of the chamber; the reaſon of this ſhortneſſe is, that one may come the more commodiouſly to the firing of the ball; the proportion of this peece followeth in the ſixteenth Figure.

B *is the form of a Morter peece lying on his carriage, the quoyn being made to draw with a ſcrew, as I have made uſe of.*

A A *the diameter or heighth of the boare, which is* $4\frac{1}{4}$ *inches, or* 100 *parts of this ſcale.*

A B *the length of the chaſe, and is two diameters, or* $8\frac{1}{2}$ *inches.*

B B *the heighth of the chamber, which is halfe a diameter of the ſhot, which is here two inches.*

B C *the length of the chamber, which is one diameter of the ſhot, that is foure inches.*

C C *the bottom of the chamber, which is one inch, or* $\frac{1}{4}$ *diameter.*

D D *the diameter of the trunions, which is halfe the diameter of the ſhot, and is two inches.*

D E *the length of the trunions, and is two inches.*

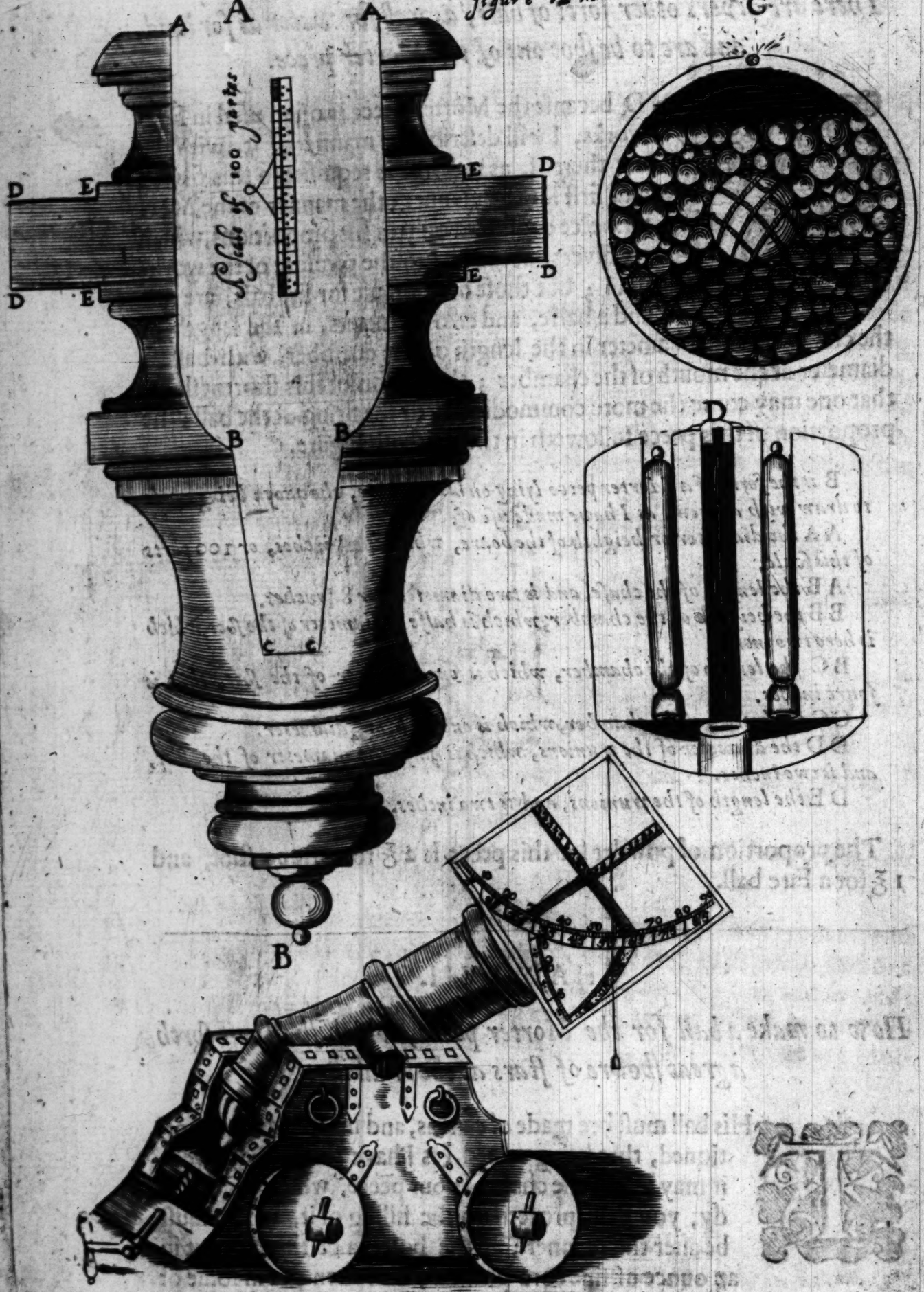
The proportion of powder for this peece is 2 ℔ for a ſtone ſhot, and 1 ℔ for a Fire ball.

## CHAP. LVII.

### *How to make a ball for the Morter peece, which ſhall caſt forth a great ſhowre of ſtars at the breaking.*

THis ball muſt bee made of canvas, and muſt bee ſo proportioned, that being armed (as I have formerly ſhewed) it may juſt fit the chaſe of your peece, which being ready, you ſhall proceed to the filling of it, which muſt be after this manner; at the bottom of this ball put in an ounce of fine corn powder, and then put in ſome of your round ſtarres well primed, and ſo fill them up cloſe about with powder duſt, ſtill putting in more of thoſe ſtarres, and in the midſt put

figure 25th



one ſtarre which may be ſomewhat great, ſo filling it till you come within one inch of the top, then fill it up with a ſlow receipt, as I have formerly preſcribed for bals; and ſew it cloſe up, arming it with fine cord, or marline, and pierce a vent in that place where your ſlow mixture lyeth, alwaies provided you pierce it not too deepe, that your ball breake not before his appointed time: then when you would uſe it, loade your morter piece with one ounce of corne powder, putting after a wadd and tampion, and put on your ball with the vent towards the mouth of your piece: ſo elevating your piece toward the Zenith, you may proceed to the firing of it, which muſt be after this manner: provide two matches ready lighted, having one in each hand, and firſt fire your ball with one hand, and preſently give fire to your Piece with the other, alwaies holding your head under the horizontall line of your Piece, for feare the blaſt annoy you: this having done, you ſhall ſee your ball mount very high, with a faire taile of fire, and when it is at higheſt, ſhall breake forth into a goodly ſhowre of ſtarres: one of theſe bals will containe almoſt one hundred ſmall ſtarres. The forme of it is repreſented in the 16 Figure, by the letter G.

C *Repreſenting the ball cut in ſunder, that you may ſee the order of the ſtars lying.*

E *The great ſtarre in the midſt, with all the reſt placed about it. Note every one of theſe ſtars muſt be primed thorow with cotton wicke, as I have formerly ſhewed.*

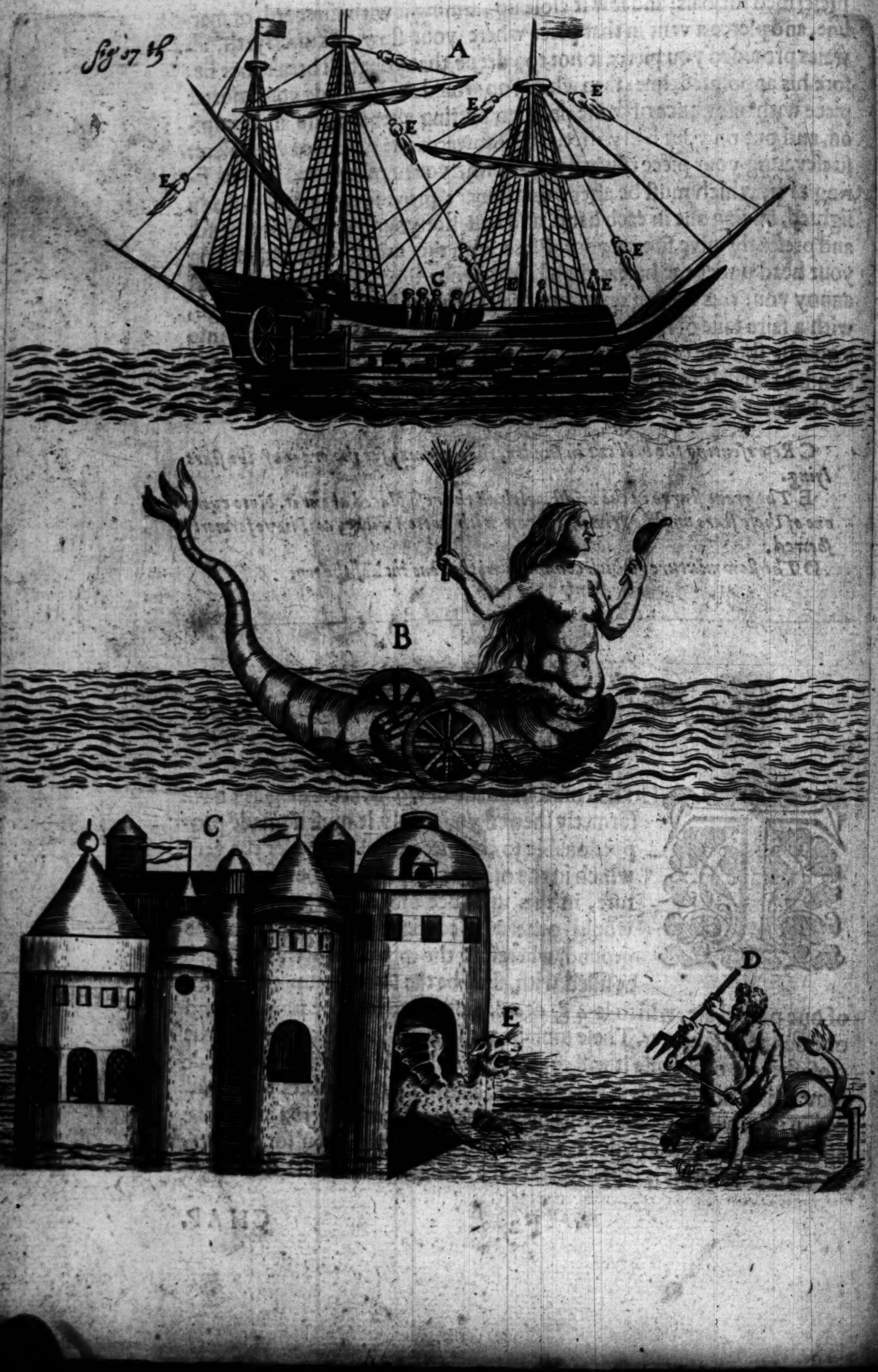
D *The ſlow mixture, which commeth within one inch of the top.*

## CHAP. LVIII.

### *Another ſort of ball for the morter piece, which ſhall caſt forth divers Rockets in the ayre.*

THis ball muſt be made of wood, according as I have formerly ſhewed you, onely it muſt be made proportionable to the piece, and moreover the vent which in the other is required to be a ſlow mixture, in this muſt bee more ſwift, in regard it would otherwiſe continue till it came to the ground, wherefore the mixture that this ball ſhall be filled with, ſhall be the ſame that your rockets of one pound are, which is 4 ℥ of coleduſt to a pound of powder, and one ounce of ſaltpeter. Theſe muſt be well mealed, and likewiſe muſt be cloſe driven, otherwiſe it will conſume too faſt. This ball may bee made ſomewhat cillindricall, in regard of the length of the rockets to be placed in it, as you have made this for to caſt forth once, ſo you may make another to caſt forth twiſe, as I have formerly ſhewed you for the water ball. The forme is repreſented in the 16 Figure, by the letter D.

Fig. 27 pl.



## CHAP. LIX.

### *How to compose a ſhip of fire workes, which being once fired, divers motions ſhall preſent themſelves.*

CAuſe a mould to be made ſo, as you may take off the upper decke, to place ſome workes underneath, where you ſhall have a fire wheele placed with a ſcrew on the axeltree; this wheele ſhall bee placed in the ſterne, and ſhall turne a rowler, on which ſhall be two girts placed, which ſhall paſſe on each ſide of the maine maſt, and runne on to the foreſhip; in this wheele there ſhall be a hollow ſpoake and axeltree, as I have formerly ſhewed, which ſhall be ſo ordered, that the wheele being ſpent, it may convey fire to a tier of gunnes lying round about, which ſhall be fired with a cloſe conveyance, and having paſſed that, it ſhall take hold of another conveyance, which ſhall give fire to certaine rockets, being placed in the bodies of ſome figures repreſenting Mariners, and ſhall be ſo fitted, that they may have a cane joyned to the body to guide them, ſo that they may runne up from the top of the deck, to the top of each maſt: this and many the like may bee performed with great facility. The forme of this is repreſented in the 16 figure A.

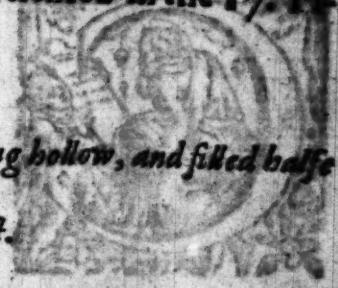
A *Repreſents the ſhip ready finiſhed, with all things in motion.*
B *The fire wheele which moveth the rowler, and carryeth the girt whereon the figures are placed.*
C *The figures placed on the girt being in motion.*
DDDD *The tier of guns which fire as the wheele beginneth to ſt and ſtill.*
EE *The figures which ſtand ready to runne up the cords; alſo you may ſee ſome in their motion halfe way, and others being got up to the top of the maſts.*

## CHAP. LX.

### *How to make the Siren or Mermaid, playing on the water.*

THis is to be formed divers waies, according to the magnitude of the figure; if you will make one of an ordinary length, which is five or ſixe foot, proceed as followeth: Let the body bee made of light rods, ſuch as basket-makers uſe, and in the center of the body, let there be placed an axeltree, having two wheeles comming into the water, yet ſo as they may not be ſeene; theſe wheeles muſt be made hollow, to containe a quantity of ſand or water; the uſe of it is to keepe the Sirene upright, and alſo to ſinke it ſo farre into the water as is needfull, and likewiſe to make it goe more ſteady; note that theſe wheeles muſt bee looſe, and the axeltree faſt; in the midſt of this axeltree, place three or

foure great rockets, one by another with their mouthes all one way, yet ſo provide, that there may be ſuch a diſtance betweene each rocket, that there may come a vent from the taile of the firſt, to the mouth of the ſecond, and from the ſecond to the third, and to the end that it may continue the longer in motion, you may place divers lights about the body, to make it more beautifull; every of each light extinguiſhing, ſhall give a report, and ſo conclude. The forme of this is repreſented in the 17. figure by the letter B.



B *Repreſents a Siren on the water.*

C *The wheeles which are looſe on the axeltree, being hollow, and filled halfe with ſand or water.*

D D *The rockets placed in the axeltree which is faſt.*

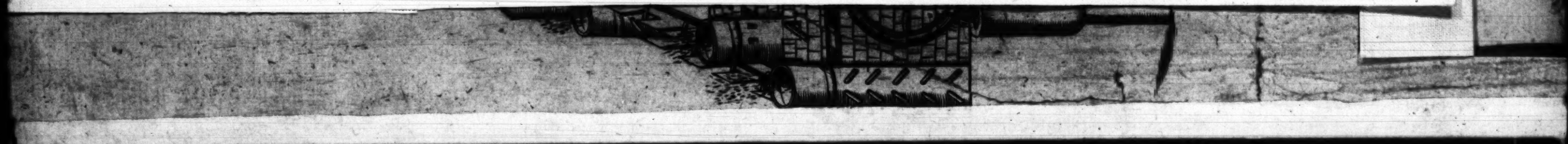
There are many other wórkes to be performed on the water, by manuall art, or the helpe of the hand: ſome of which I will ſhew, the reſt I ſhall leave to the iudgement of judicious workemen in that art; in regard there are ſea fights, which are performed by gallies placed on the water, with the helpe of Mariners acted; and likewiſe Caſtles placed both on the water, and on the ſhoare; all which doe repreſent ſome former ſtory of the like: yet know this, there are many motions, to be wrought by hand, after a more ſecret manner, which will cauſe more admiration, and is done by certaine lines placed under the ſuperficies of the water, the ground of which I will ſhew you.

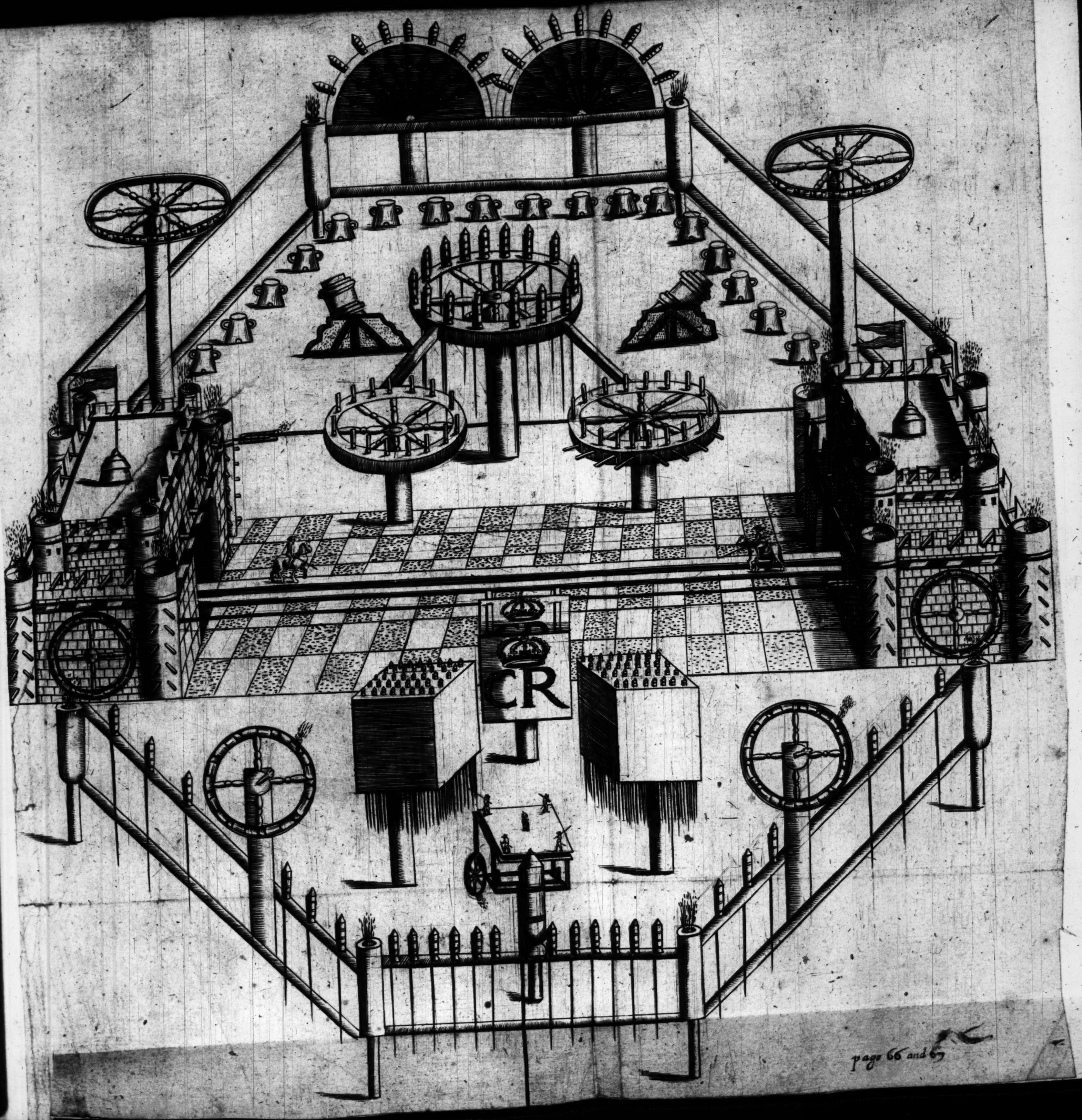
## CHAP. LXI.

### *How to repreſent a Dragon iſſuing out of a Caſtle, which ſhall ſwimme thorow the water, and be incountred by a horſeman from the ſhoare.*

CAuſe a Caſtle to be made on certaine timber, ſo as it may floate, if it be in a flowing and ebbing water, and let the bottome of the doore of this Caſtle, with the ground plat, be two foot under the horizon of the water (the reaſons follow) and at a foot high within the Caſtle, let there bee a certaine line tyed, which may paſſe thorow the body of the Dragon, and may bee faſtened neere the ſhoare, where you ſhall have a floate likewiſe ſunke ſo farre under water, that the line may not be perceived, then faſten on your Dragon, as I have formerly ſhewed you for the line, but ſo that the head of this may alwaies be above the line, where that was under: then when the time appointed comes, there ſhall be one ready within the Caſtle to fire thoſe parts of the Dragon which is requiſite, which being done by the helpe of thoſe pullies, ſhall paſſe it thorow the water, which ſo ſoone as it preſents it ſelfe, *Neptune* (as being diſpleaſed to ſee ſo monſtrous a creature within his bounds) ſhall come and encounter the ſaid Dragon,

and






page 66 and 67

and at last shall overthrow him: you may order your work so, that which you please shall have the victory, for that which keepeth fire longest, is supposed to have the best, and that which is soonest spent, to have the worst. Many rare things may be done in this for the pleasure of Princes, which are to be acted on the water, which for brevity sake I omit: onely I shall shew you the order of composing two sorts of workes, the one to be acted on the land, the other on the water. The forme of this worke is represented in the 17 Figure, by the letters C D.

G *Representing the Castle floating on the water, out of which the Dragon issueth.*

E *The Dragon comming forth of the Castle.*

D Neptune *comming towards the said Dragon to encounter him.*

F *The pully which causeth these motions by meanes of drawing them to and from each other: the manner of fashioning the line for drawing them, I have shewed you before in the 33 Chapter.*

## CHAP. LXII.

### *An order for a generall piece of fire-worke for land, and is for the pleasure of a Prince or some great person.*

CAuse a frame to be made of wood, which let be eight square, or more properly eight sided (which is the best figure for this purpose) and let it bee forty yards from one side to the other, there place two Castles the one opposite to the other, which Castles shall be eight foot square, these Castles shall be fitted with motions, as I have formerly shewed you, some comming outagainst others, some moving on the walles; all which may bee performed by the helpe of large fire wheeles, which must be at the least sixe foot diameter, with large Rockets for the same purpose, as I have formerly shewed you: then on the foure adjacent sides, you shall place foure other wheeles, two running horizontall, and two vertical; and on the other two sides you shall place rockets, some flying upright, and others circular; at each angle or corner, there shall be placed a torch of a beautifull fire and flow; so much for the sides: now you shall come to fill up the vacuum betweene the sides, alwaies noting that from one Castle to the other, passeth a frame of wood, the use whereof I have formerly shewed, then before the midst of this frame, there is placed on the one side, two square cases of rockets, and betweene these cases toward the bottome, and somewhat before, there is placed anticke motions, and to the angles of each Castle are placed two lines, with runners which take fire, and passe to and fro; note the end of those lines must be perfect wyer, or else the fire would burne them, then on the same side behinde the motions, shall stand aloft a frame with the Kings name or the like; then on the other side of the frame,

within

within the vacuum, ſhall be placed three ſtanding wheeles, whereof the one ſhall caſt forth rockets into the ayre, the other two are for reports and fiſgigs, theſe three wheeles ſhall ſtand in a triangular forme, and ſhall have a frame paſſe from the one to the other, and betweene the angles of theſe wheeles, ſhall be placed two mortar pieces, which ſhall bee to caſt fire bats, with divers workes in them. The manner of this is repreſented in the 18 Figure.

## CHAP. LXIII.

### *Another order for a generall worke, and is to be acted on the water.*

HAving a place appointed for your worke, (which muſt be in ſome ſpacious River) you ſhall ſeeke the moſt convenient place on the ſhoare for placing a Caſtle, which ſhall bee made to repreſent ſome City or Fort lying on the water, this Caſtle ſhall be furniſhed with all manner of workes, as well fire bals, as rockets, with divers ſmall Ordnance to give a more grace to the worke; this being provided, you ſhall alſo make another Caſtle on the water, on certain boats chained and lying at anchor, theſe ſhall bee ſet at a reaſonable diſtance from the other, about twenty ſcore, or as your place will permit: in this Caſtle likewiſe you ſhall provide workes, as in the other, onely this Caſtle may not be ſo big as that on ſhoare, then you ſhall provide divers ſmall ſhips, which ſhall be ready to make a ſea fight: theſe ſhall be ſo divided, that the greater part may belong to the ſmaller Caſtle on the water, and likewiſe for ſurpriſing that on the land; likewiſe you may have motions paſſing from one Caſtle to another, as I have formerly ſhewed you for the water; amongſt the reſt you ſhall have ſome ſmall fire ſhip, ſuch as I have ſhewed you, which ſhall have divers motions: now there are many actions to be performed by theſe workes, as caſting bals from one Caſtle to the other, with the morter pieces, likewiſe ſending backe rockets to each other, with divers onſets on each ſide for ſurpriſals, all which I leave to the diſcretion and appointment of the iudicious workeman; and becauſe I will not trouble you with prolixity, I will conclude this my Pyrotechnia; onely I will at laſt impart that which is not the leaſt, which is the making of certaine Engines for trying of powder, of which I ſhall ſhew you foure, with the uſe of them in the enſuing Chapters, and ſo conclude.

CHAP.

## CHAP. LXIV.

### *Of the use of certain Engins for the trying of the goodnesse or strength of powder.*

BEfore I come to explaine the manner of making those Engins, I will shew you the commodiousnesse of them, especially in these works; for hee that will make a good rocket, must be certain of the strength of his powder, which if it bee too strong, will break; if too weak, it will not rise to that heighth it should; which, I must confesse, hath been a great losse of labour to me, as well as to other men, yet if men will be so carefull and take that paines for the trying their powder, they may make rockets infallible; therefore I advise every man that will work sure, first to take his powder, be it what it will, and allay it according to the rules prescribed, then take a quantity of that mixture, and put it into your Engin being exactly weighed to a graine, then drive your rocket, and be sure to follow the former rules prescribed in driving your rockets, which being finished, with his works upon his head, you may fire it, which if you shall finde to bee too violent, you may allay by putting thereto a proportion of coale, and so try it again, till such time you finde it to be the best, then note that proportion for all rockets of that size, and so do for all others; and if you finde your mixture yet too weak, adde thereto a small quantity of roch peter till you make it of sufficient strength; and thus doing, you shall have a certain and infallible rule for your proportions: I could set down the proportions according to my Engins, but that would prove an absurdity, in regard every Engin may have a greater or lesser strength added to his springs, or the like, as you shall perceive in the next Chapter.

## CHAP. LXV.

### *The manner of making the aforesaid Engines for trying the strength of powder.*

THE first is made in a circular form, with a neck comming from the circumference, which serves for a lid to the powder box, which box shall bee made to hold the quantity of a dram of powder, or there about, so that being covered with the lid, and fired, will blow, according to the strength of the powder, and moving, will turn about a circle of brasse, which is divided into certain equall parts, and so will shew the strength according to the part it cutteth; for the greater the degree is that it is blown

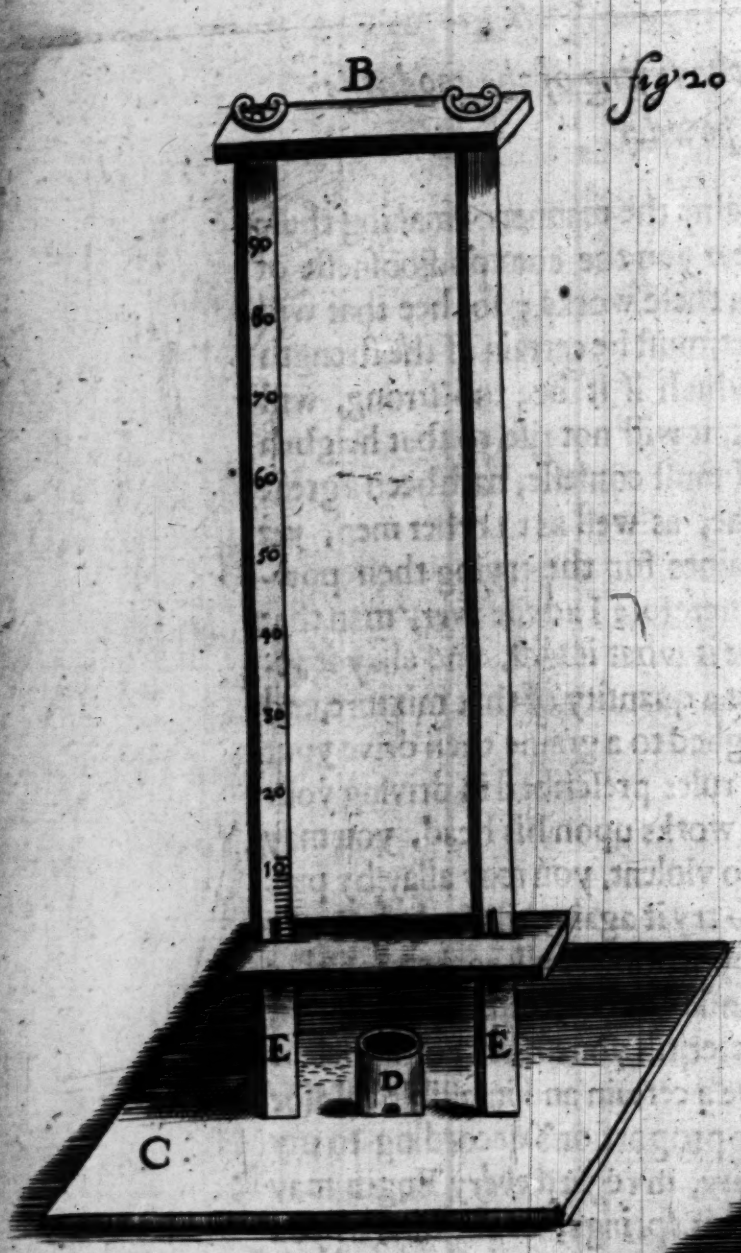
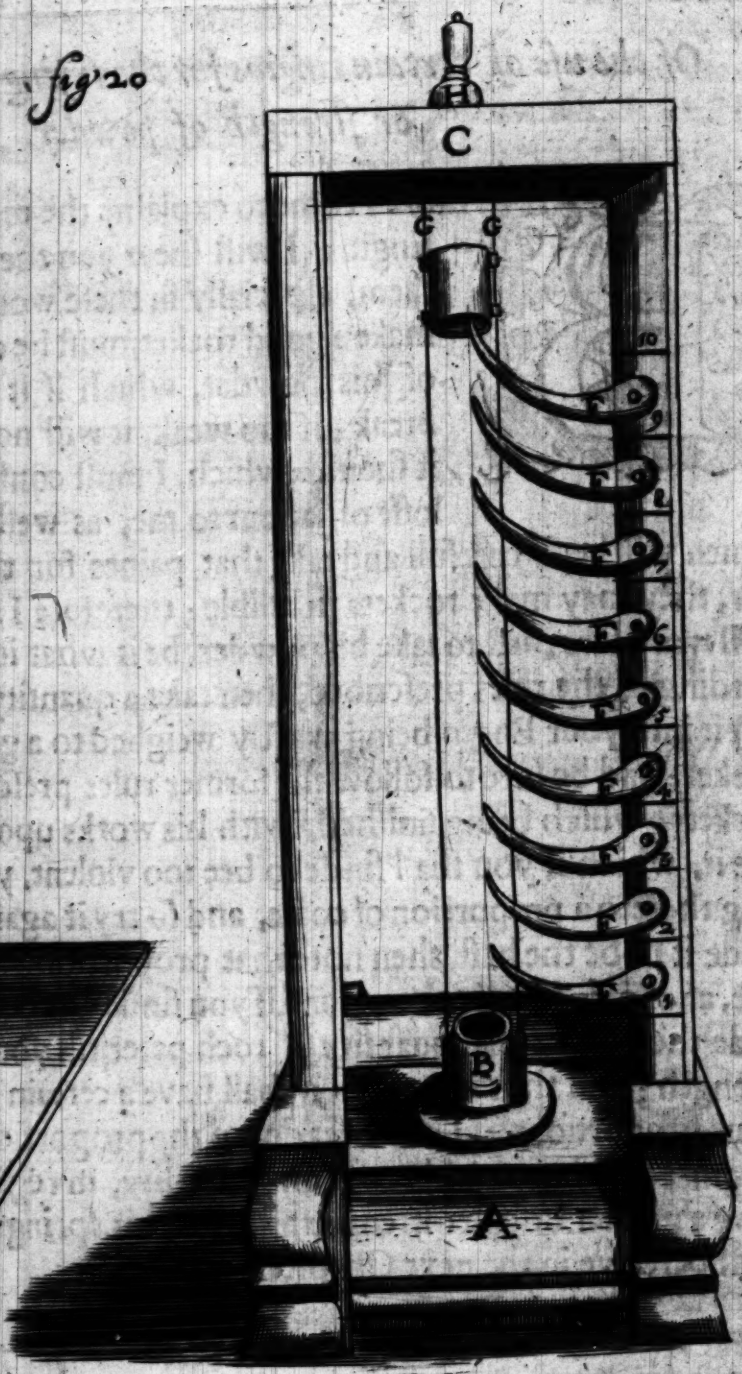
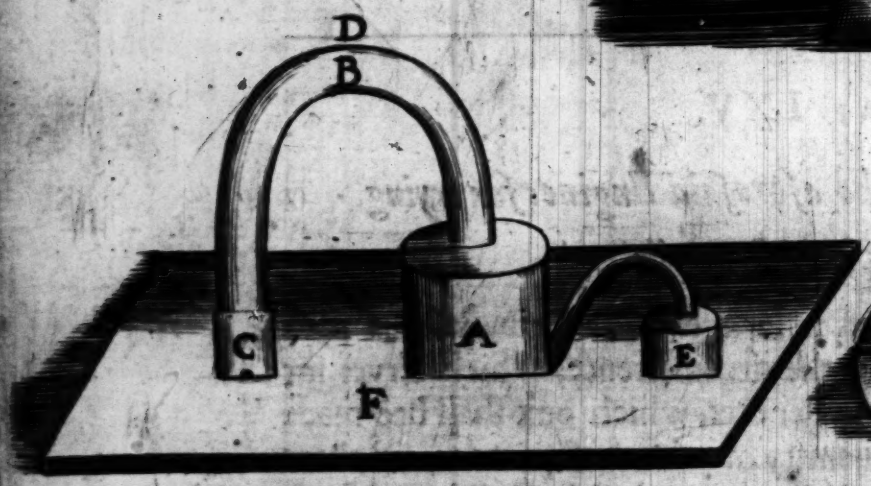
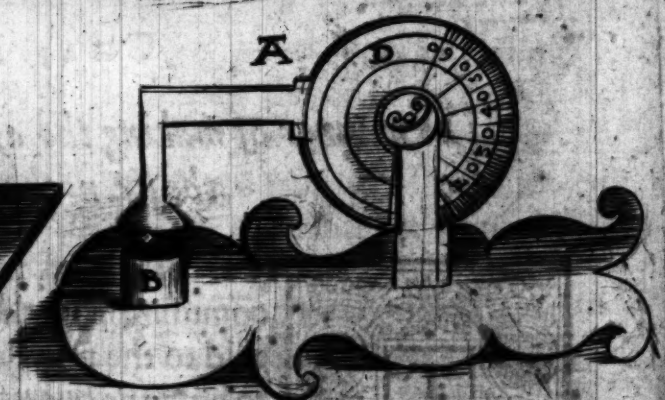



fig. 20



up to, the ſtronger is the powder, and contrary. The form of this is repreſented in the twentieth Figure, by the letter A.

A *repreſenting the form of the whole Engin.*
B *the powder box, which muſt be filled to the top.*
C *the lid, which muſt be put on the ſayd box, it being filled.*
D *the circle of braſſe to which the lid is faſtned, which is divided into degrees, and runneth upon the pin* E, *paſſing thorow the center, with a ſcrew to ſet it harder or eaſier.*

## CHAP. LXVI.

### *Another Engin for trying of powder.*

THE lid of this ſecond ſort is made to riſe in a ſtraight line, and hath for his guide two ſquare pillars of braſſe, divided into degrees, with ſprings to keep it ſteaddy in this motion; this muſt be made on a ſquare peece of braſſe, with the ſmall box in the midſt, and two ſquare pillars on each ſide, with a peece of braſſe to ſlide up and down by thoſe pillars, and muſt ſerve for a cover for your powder box; this peece of braſſe muſt have ſmall ſprings, which muſt go to each ſide of the ſquare to guide it ſteaddy in the motion. The form whereof you ſhall finde in the twentieth Figure, by the letter B.

B *the whole frame, with his parts adjoyned.*
C *the ſquare plate of braſſe, on which all is faſtned.*
D *the powder box, ſtanding in the midſt of that plate.*
EE *the two ſquare pillars of braſſe, ſtanding on this foot, and may bee made to ſcrew off and on at pleaſure.*
F *the lid to the fire box, which is made to ſlide up the two ſquare pillars.*
GG *the ſprings, which are faſtned to the lid, to make it move more ſteaddy.*
*The diviſions* 10, 20, *&c. ſhew of what ſtrength the powder is, for the higher that the lid riſeth, the ſtronger is the powder.*

## CHAP. LXVII.

### *A third Engin for trying the ſtrength of powder.*

THE third ſort are made ſomewhat after the manner of the former, which is to riſe up ſtraight, only it hath a cover hollow as big as the box, and on each ſide of the cover is a ſmall hole for a wyer to paſſe thorow, and on one of the ſides are little peeces of ſteele or braſſe, ſo fitted, that they will riſe with a touch, and give way to the riſing of the lid, and ſo ſoon as it is paſt, will hold it there, and will not ſuffer it

it to passe down any further ; this I hold to bee the best of the three, in regard that the springs in the former are subiect to grow foule with use, and so will be very stiffe, every time more and more ; but this will not. The forme of this is represented in the twentieth Figure, by the letter C.

A *the foot whereon the Engin standeth.*
B *the powder box, which hath two small wyers passing from each side to the top, to guide the lid.*
D *the lid, which hath also two holes on each side for the wyers to passe thorow.*
E *the side which is divided, on which is placed at every degree, one of those peeces to slide up and catch the lid.*
F F *the forme of those catches, being either of steele or brasse.*
G G *the two wyers which guide the lid of the box, and must bee put into a little peece of brasse at the top, which may bee screwed higher or lower at pleasure, for the straightning of the same.*
H *the screw which straightneth those wyers.*

## CHAP. LXVIII.

### *Another Engin for trying the strength of powder by water.*

THE fourth, and most certainest way of all, is by water, and is thus ; cause a small vessell to be made of brasse, and very tight, so as it may containe a pinte of water ; let this vessell bee made in a cillindricall form, and from the top of this vessell let there bee made a pipe of brasse, which shall turne like the siphon, and shall have a screw at the lower end, to screw into a box of brasse ; all which shall stand on a woodden frame : now when you wil use this, you shal fil this great vessel halfe ful of water, at a pipe which shal come from the bottom, and come up to the top winding, then shal there be likewise another vessel underneath for a receiver, so that putting a quantity of powder into the smal box, and screwing it on, it is ready ; then fire the powder, and you shal see it send forth a quantity of water, which you shall weigh, and so keep the weight of it, by this you shal know what quantity of powder of such a goodnesse wil send forth such a quantity of water ; this I hold to be the certainest way, although the most troublesome. The form of it is represented in the twentieth Figure, by the letter D.

A *representing the vessell of water, which shall be alwayes filled one halfe.*
B *the pipe of brasse which passeth from the powder box to the vessell of water.*
C *the powder box, being screwed to one end of the said pipe.*
E *the receiver, to receive such water as is forced out.*
G *the pipe which conveyeth that water into the receiver.*
F *the bottom being of wood, with a plate of brasse let into it.*

8 00 68

FINIS.